The Taxonomy of the Myzini (Homoptera: Aphididae) of the Eastern United States

By

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Abstract of Dissertation Presented to the Graduate Council of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

The Taxonomy of the Myzini (Homoptera: Aphididae) of the Eastern United States

By

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The tribe Myzini (Homoptera: Aphididae) includes the genus Myzus and the following related genera in the Eastern U.S.: Phorodon, Hyalomyzus, Ovatus, Utamphorophora, Aulacorthum, Rhodobium, and Fimbriaphis.

The 8 species of Myzus which occur in the Eastern U.S. are described and illustrated. Nectarosiphon is declared to be invalid as a subgeneric name within Myzus, and persicae and certus are included in Myzus without subgeneric designation. Lectotype, morpholectotype, paralectotypes, and plesiotypes of varians are designated.

The 13 species in the 7 genera related to Myzus are described and illustrated. The genus Utamphorophora is redescribed and plesiotype sexuales of U. humboldti are designated. Lectotype, morpholectotype, allolectotype, and paralectotypes of Fimbriaphis scammelli are also designated.

INTRODUCTION

In North America today, Drs. Quednau and Richards in Canada are studying the Callaphidini; Dr. C. F. Smith at North Carolina State University, the Eriosomatinae; Drs. Boudreaux and Rolston at Louisiana State University, the Macrosiphini; and Dr. J. O. Pepper, Pennsylvania State University, and Dr. A. N. Tissot, University of Florida, the genus Cinara. Aside from the genus Aphis, the Myzini is the only major group of aphids which has not undergone a recent study. For this reason, I chose to study this tribe within the eastern United States.

Terminology

Morphology. A drawing of a generalized myzine aphid is shown in Figure 1. The eyes are many-faceted with 3 facets in the ocular tubercles. Ocelli are also present in alatae.

The front of the head may bear frontal extensions, the antennal tubercles, which form the bases for the antennae. The antennae are usually 6-jointed, the joints frequently numbered from base to apex by Roman numerals; the last joint is separated into the base, from the proximal end of the segment to the distal end of the primary sensorium, and the terminal filament (processus terminalis), from the distal end

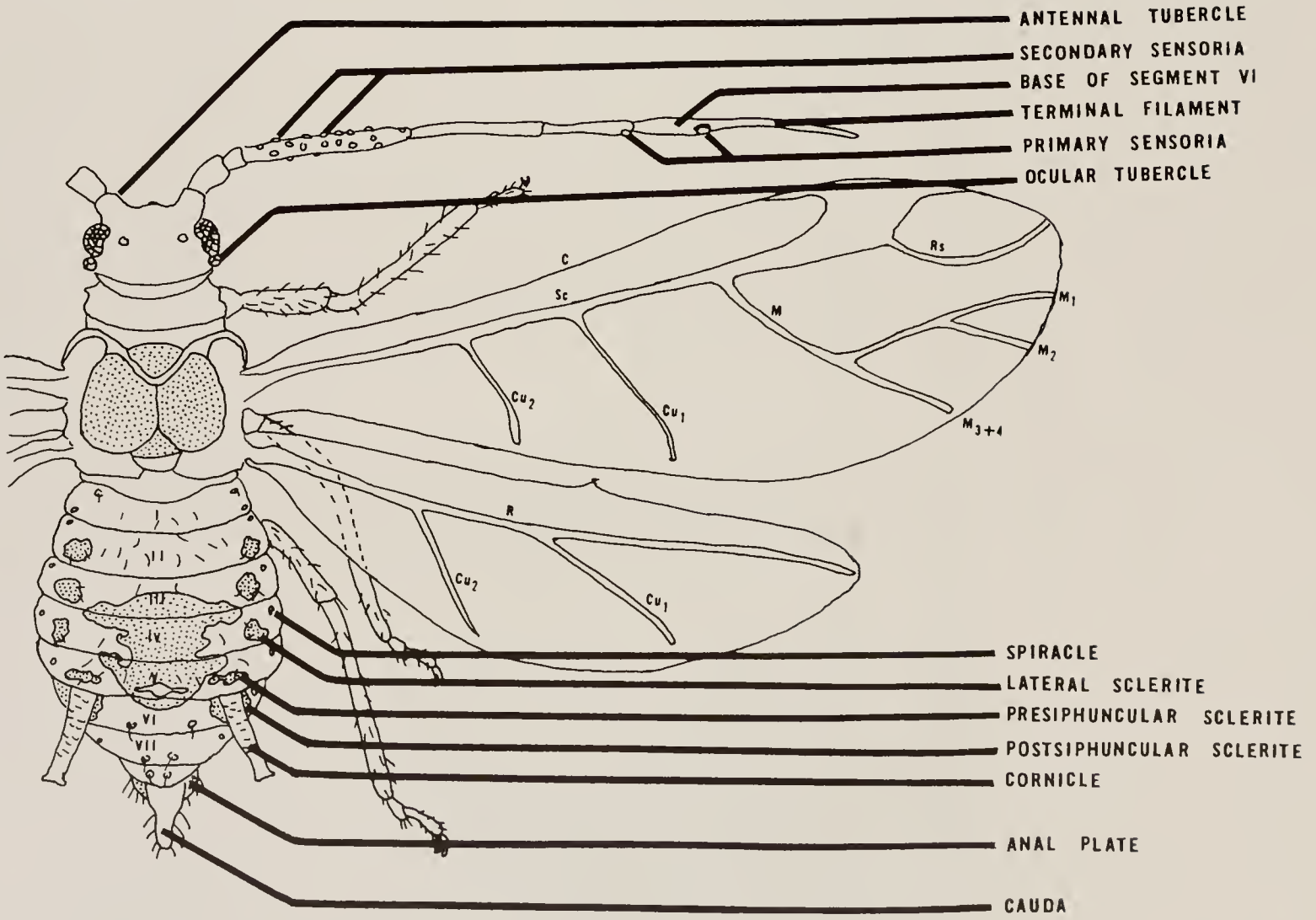

Figure 1. Diagram of a generalized myzine aphid (after Bodenheimer and Swirski 1957).

of the primary sensorium to the end of the segment. Primary sensoria are located near the terminal end of segment V and at the distal end of the base of segment VI; these usually have a ciliated margin. There are also 4-7 small sensoria without ciliated margins clumped next to the primary sensorium on segment VI; these are generally considered to be part of the primary sensorium. Secondary sensoria may be present on any or all of segments III-V in alatae; they are only occasionally present in apterae. The secondary sensoria are generally without ciliated margins.

The rostrum is 5-jointed but the distal segment is so reduced that segment IV + V is considered to be a single segment.

The legs are composed of the usual parts: coxa, trochanter, femur, tibia, tarsus. Oviparous females usually have the hind tibiae swollen and bearing various numbers of pseudosensoria. The tarsi are 2-jointed.

The typical wing venation is shown in Figure 1. Occasionally veins may be reduced or missing on one or both pairs of wings.

The abdomen is composed of 9 (or according to some authors 10) segments. Eight distinct tergites are visible. The cauda, a prolongation of the last abdominal tergite, is usually well developed. Lateral sclerites are located above the spiracles on segments (I) II-IV; a presiphuncular sclerite (lateral sclerite on segment V located in front of the cornicle base) and a postsiphuncular sclerite (lateral sclerite

on segment VI behind the cornicle base which may extend to segment VII) are also usually present. Lateral tubercles may be present on any or all of the sclerites on segments (I) II-IV and rarely on the presiphuncular sclerite; dorsal or spinal tubercles may occur on segment VII and/or VIII. The cornicles (siphunculi) arise dorsolaterally between segments V and VI. The anal plate is situated below the cauda on the venter of segment VIII. In viviparae and oviparae there is a genital plate on the venter of segment VII.

Life cycle. The nymph that hatches from the egg matures into the fundatrix, or stem-mother, an apterous viviparous female usually with shorter antennae, legs and cornicles than subsequent apterae and with antennae frequently 5-segmented. The fundatrix gives birth to fundatrigeniae which may or may not differ morphologically from subsequent generations. The first generation fundatrigeniae and all subsequent generations produced on the primary host, which may also be called fundatrigeniae, are primary viviparae (primary virginoparae, i.e., "produced on the primary host, offspring of virgin mothers").

Alate fundatrigeniae (migrantes) migrate from the primary to the secondary host where they give birth to secondary virginoparae. The alate virginogeniae which migrate to other plants of the same species or to other secondary hosts are termed vagrantes; this same term may be applied to alatae of autoecious species infesting other primary hosts.

The alate virginogeniae which return to the primary host

are called remigrantes. They may also be called gynoparae if they give birth to oviparous females or sexuparae if they give birth to both oviparae and males. Frequently however the males are produced on the secondary host and fly to the primary host.

In southern regions virginogeniae frequently live parthenogenetically throughout the year without the formation of sexuales.

Literature Review

The genus Myzus was erected by Passerini (1860) with Aphis cerasi Fab. as type. Myzus with its related genera was included in the Nectarophorini with Nectarophora Oestlund (= Macrosiphum Passerini) in America (Williams 1910); Europeans placed it in the Siphonophorini with Siphonophora Koch (= Macrosiphum Passerini) (van der Goot 1915, 1917). Passerini's replacement of Siphonophora by Macrosiphum (1860) became widely used only after Schouteden (1901) published his synonymy of the genus Macrosiphum. Myzus, Macrosiphum and Amphorophora were then generally placed together in the Macrosiphini (Wilson 1910, Swain 1919, Blanchard 1922, Nevsky 1928, Hottes and Frison 1931, Gillette and Palmer 1934, Eastop 1966). A few authors (Nevsky 1929, Cottier 1953, Bodenheimer and Swirski 1957) placed these genera in the subfamily Aphidinae and did not attempt further discrimination.

The use of a separate tribe for Myzus and closely related genera was first proposed by Mordwilko (1934) and has since

been adopted by many authors (Börner 1952b, Shaposhnikov 1956, Heinze 1960, 1961, Aizenberg 1966, Quednau 1966). Börner (1952b) and Heinze (1960, 1961) divided the subfamily Myzinae into the following tribes and genera: Brachycolini (Brevicoryne, Coloradoa, Hyadaphis, Lipaphis), Cryptomyzini (Capitophorus, Cryptomyzus), Liosomaphidini (Cavariella), Myzaphidini (Chaetosiphon, Longicaudus, Myzaphis), Myzini (Myzus, Neomyzus, Pentalonia), Nasonoviini (Hyperomyzus, Idiopterus, Nasonovia, Rhopalosiphoninus) and Phorodontini (Myzodes, Ovatus, Phorodon, Rhopalomyzus, Sciamyzus). The Myzini were separated from the Phorodontini principally on the basis of the presence of spines between the setae on the hind tibiae of first instar nymphs in the former and the absence of these spines in the latter. However, this separation is not valid since it works with European aphids but not with the Oriental fauna (van Emden et al. 1969). Therefore, the Myzini, as used in this paper, correspond in general to the Myzini and Phorodontini of Börner (1952b) and Heinze (1960, 1961).

Evolution of the Myzini

According to Mordwilko (1934), Börner (1952b) and Shaposhnikov (1956), the Myzini, through the genus Myzus, evolved from the Anuraphidini, the members of both groups retaining the primitive relationship with the Rosaceae as primary hosts. Mordwilko (1934) noted that spinal tubercles, which were usually well developed in Myzus, were not developed in Anuraphis

and Dysaphis in the Anuraphidini; but, nevertheless he proposed that all three genera should be grouped together since they share Rosaceae as primary hosts, Myzus on Prunoidea and Anuraphus and Dysaphis on Pomoidea.

Shaposhnikov (1956) considered the Myzini to be intermediate between the Anuraphidini and the Macrosiphini. He noted that the spinal tubercles and cuticular sculpturing were well developed in Myzus but not in Anuraphis and Dysaphis, supposedly marking the two groups as being distantly removed; however, Dysaphis had well developed antennal tubercles similar to those in Myzus. Furthermore, the cauda in Myzus was not as well developed as in the Macrosiphini but the shape of the body and imbrications on the cornicles were similar.

Aizenberg (1966) considered Myzus and the Myzini to be closely related to the Macrosiphini based on the structure of the cauda, the absence of lateral tubercles on abdominal segment VII, and usually also on segment I, the well developed antennal tubercles and the structure of the setae on the body.

Characteristics of the Tribe Myzini

Body size medium to large, usually 1.0-2.6 mm, ovate to obovate. Color usually green or yellow. Antennal tubercles very prominent, parallel to strongly corverging and scabrous. Antennal segments I and II usually scabrous; I usually with a variably developed projection on the medial surface, rarely rounded. Antennae usually 6-segmented;

terminal filament at least 1.5 times the length of the base of antennal segment VI and usually 3.5-4.5 times that length. Alate viviparae with secondary sensoria on antennal segment III only, on III and IV, or on III, IV and V; apterous viviparae usually without secondary sensoria, present only in Aulacorthum and Rhodobium. Eyes normal; apterae without ocelli. Rostrum moderately long, with segment V reduced so that IV + V appears to be a single segment.

Legs normal; first tarsal segments usually with 3 setae, occasionally 2 on the first hind tarsal segment. Mesothoracic furcula of apterae consists of a short stalk with blunt lateral projections. Wing venation normal, sometimes reduced; occasionally with bordered wing veins.

Alate viviparae with pigmented lateral abdominal sclerites and usually with a pigmented dorsal patch; apterae rarely with a pigmented patch on the abdomen. Lateral abdominal tubercles always absent on segment VII and usually also on segment I; spinal tubercles may be present on segment VII and/or VIII. Cornicles well developed, 1/5-1/3 the length of the body, cylindrical or swollen, usually imbricated and rarely with closed reticulations apically; if so, the dorsum of the abdomen has a pigmented patch or transverse bars. Cauda moderately developed, usually 1/3-1/2 the length of the cornicles, conical, with 2-3 pairs of lateral setae.

Oviparae usually resemble apterous viviparae except for their swollen hind tibiae which bear varying numbers of pseudosensoria. Males similar to alate viviparae, usually alate,

rarely apterous. Fundatrix similar to apterous viviparae but antennae, legs and cornicles shorter; antennae frequently 5-segmented and antennal tubercles usually not developed.

METHODS AND MATERIALS

Geographical Scope

The eastern United States as defined for this study consists of those states east of the Mississippi River plus Louisiana and the District of Columbia. This includes, in alphabetical order, Alabama, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Michigan, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia and Wisconsin.

Mounting Technique

Aphids were mounted following the procedure of Tissot and Pepper (personal communication). After storage in 70% alcohol, the venter of the abdomen was slit, using minuten pins, from approximately segment I to a point just in front of the genital plate.

The specimens were placed in 5% KOH (or NaOH) in a boiling water bath for approximately 5 minutes. It is important that the KOH not boil. (I found that aphids placed in a beaker with 5% KOH in running hot tap water for 15 minutes, or left in cold 5% KOH for 2 days gave satisfactory results with less chance of damaging the specimens.)

The aphids were removed from the KOH, washed gently in water and transferred to 70% alcohol. Minuten pins were used to remove embryos, digestive tract, and other soft tissues from the inside of the abdomen.

The aphids were then successively placed for 15 minutes each in absolute alcohol, 3 parts absolute alcohol in 1 part clove oil, 1 part absolute alcohol in 1 part clove oil, and finally in clove oil.

The aphids were mounted from clove oil directly into Canda balsam.

A variation of this procedure (Pepper, personal communication), which replaced the clove oil mixtures with a saturated solution of chloral hydrate in absolute alcohol, was tried. Although this proved to be successful, it could be used only if the chloral hydrate solution was freshly mixed because it was not stable and must be replaced at approximately monthly intervals.

When remounting old slides, the cover slip was soaked off in xylene or Euparol® Essence (Flatters & Garnett Ltd., Manchester, England) depending on the mounting medium and the aphids were transferred to 5% KOH in a boiling water bath for 5 minutes. After cooling, the specimens were placed in 70% alcohol and the abdomens were slit and cleaned. The aphids were returned to 5% KOH in a boiling water bath and the procedure followed the same steps as outlined above for fresh specimens. The original labels were kept and placed on the remounted slide.

Organization

Mounted specimens were borrowed from several sources. These sources are abbreviated as follows: U.S. National Museum of Natural History - USNM; the Florida State Collection of Arthropods (including the collection of Dr. A. N. Tissot) - FSCA; Dr. C. F. Smith, North Carolina State University, Raleigh, North Carolina - CFS; Dr. J. O. Pepper, Pennsylvania State University, State College, Pennsylvania - JOP; Dr. H. B. Boudreaux, Louisiana State University, Baton Rouge, Louisiana - HBB; Dr. H. G. Walker, Los Angeles State and County Arboretum, Arcadia, California - HGW; and, Dr. D. Hille Ris Lambers, Bladuisonderzoek T. N. O., Bennekom, Holland - HRL.

The descriptions given are based entirely on specimens I studied and therefore may differ slightly in ranges of measurements given in other publications. The list of specimens studied is summarized in the section "Collections studied"; this section is followed by abbreviations for the depositories in which these slides can be found and, when applicable, references to other host plant lists. The collections are arranged geographically by states, North to South and East to West, and alphabetically by localities within states. Since Myzus persicae, M. ornatus and Aulacorthum circumflexum are so polyphagous, the collections for these species have been reduced to lists of host plants, alphabetically by families and alphabetically by species within

families. Gray's Manual of Botany was used as the source for plant family names.

Even though the geographical scope of this paper is limited to the eastern United States, specimens from outside the area were studied so that a proper assessment of variation could be made; these records from outside the area are included in the "Collections studied."

All studies were made with a phase contrast microscope and therefore the color of mounted specimens appears to be yellower than with a direct light microscope. All measurements are in mm. Body length was measured from the vertex of the head to the apex of the anal plate. Head width is width across the compound eyes. Cauda length is total length from base to apex.

The drawings are line tracings of 8 X 10 enlargements of photomicrographs of the specimens. The line drawings were then reduced to fit within the allowable margins.

The keys apply only to alate and apterous viviparous females and, unless stated to the contrary, characters will apply to both morphs.

KEY TO EASTERN U.S. GENERA OF MYZINI

1. Rostral segment III with 2 pairs of lateral setae..... 2
   Rostral segment III with at least 3 pairs of lateral setae..... 7
2. First hind tarsal segment with 3 setae..... 3
   First hind tarsal segment with 2 setae.....Myzus (in part)
3. Cornicles swollen (Fig. 4, 6)..... 4
   Cornicles cylindrical (Fig. 2, 3) or constricted medially (Fig. 9)..... 5
4. Alate viviparae occasionally with a dorsal sclerotic patch; apterous viviparae usually with 1-3 secondary sensoria basally on antennal segment III.....Utamphorophora
   Alate viviparae without a dorsal sclerotic patch; apterous viviparae without secondary sensoria on the antennae.....Hyalomyzus
5. Cornicles cylindrical; alate viviparae with secondary sensoria in a more or less straight line on antennal segment III; if sensoria scattered on segments III and IV, abdomen with dorsal sclerotic patch..... 6
   Cornicles constricted medially; alate viviparae with numerous secondary sensoria on antennal segments III and IV; if in a more or less straight line on segment III, abdomen without a dorsal sclerotic patch.....Ovatus
6. Antennal tubercles with elongate finger-like projections (Fig. 7); sensoria numerous and scattered on antennal segment III; 1-4 sensoria also present on segment IV; wing veins without fuscous borders.....Phorodon
   Antennal tubercles without elongate finger-like processes; sensoria in more or less straight line on antennal segment III; if numerous and scattered over segment III and also present on IV, then wing veins with conspicuous fuscous borders.....Myzus (in part)
7. Cornicles without closed reticulations apically.... 8
   Cornicles with closed reticulations apically (Fig. 11, 12).....Aulacorthum

8. Alate viviparae with sensoria with ciliated margins and in a more or less straight line on antennal segment III; apterae without secondary sensoria; cauda more than 1/2 the cornicle length; alate viviparae occasionally with a dorsal sclerotic patch on the abdomen.....Fimbriaphis

   Alate viviparae with scattered sensoria without ciliated margins on antennal segments III and IV; apterae with 4-19 sensoria on antennal segment III; cauda less than 1/2 the cornicle length; alate viviparae without a dorsal sclerotic patch on the abdomen.....Rhodobium

GENUS MYZUS PASSERINI

Myzus Passerini 1860:27.
Rhodopalosiphum Wilson nec Koch 1910:320.
Myzoides van der Goot 1915:167. - 1917:47.
Myzodes Mordwilko 1914:69.
Myzus (Nectarosiphon) Hille Ris Lambers nec Schouteden 1946:197.

Wilson (1910) designated Aphis persicae Sulzer as type of the genus Rhopalosiphum. However, Gerstacker (1853, in Börner 1951) had designated Aphis nympheae L. as type for Koch's genus Rhopalosiphum. Therefore, Rhopalosiphum Wilson nec Koch is a full synonym of Myzus Pass.

Van der Goot (1915) placed species with elongate capitate setae and sensoria on antennal segment III of apterae in Myzus while placing other species of Myzus in Myzoides n. gen. Therefore, Myzus van der Goot nec Passerini is a synonym of Capitophorus van der Goot and Myzoides is a synonym of Myzus Pass.

The major problem in synonymy of the genus Myzus, viz., Myzus (Nectarosiphon) vs. Myzodes, is still prevalent today and deserves explanation.

Koch (1854) established the genus Siphonophora for those species of Aphis L. which Kaltenbach had characterized in 1843 by: "Letzteres Fuhlerglied gorstenförmig und langer als das vorletzte. Die Fuhler stehen auf einem hokerartigen Stirnknopfe. Stirne tief rinnenförmig." ("Last antennal segment bristly and longer than thenext to the last. An-

tennae sit on bumps on the front of the head. Front deeply groove-like.") However, the name Siphonophora had been used by Brandt (1840, in Schouteden 1901) for a genus of Myriapods, and since his generic name had priority over that of Koch, Passerini (1860) suggested that Siphonophora Koch be replaced by the new name Macrosiphum but he himself did not use the latter designation for several years. Oestlund (1887), unaware of Passerini's action, replaced Siphonophora Koch with Nectarophora, which was subsequently adopted by American authors.

In 1886, Oestlund erected the genus Macrosiphum for M. rubiculum, close to Siphonophora rubi Kalt., a species with very swollen cornicles. Del Guercio (1900) also used the name Macrosiphum for species with slightly swollen cornicles.

Schouteden (1901) discovered Passerini's name and sought to clear up the multiplicity of uses of "Macrosiphum" with the following (p. 111) (translation from French; underlining my own): "In his remarkable work on the Italian aphids (Prospetto dell' Afidofauna Italiana), which appeared last year, Professor G. Del Guercio established a new genus containing the species with slightly swollen cornicles (rubi Kalt., convolvuli Kalt., viciae Kalt.) in addition to the genus Siphonophora; this second new genus he designated under the name Macrosiphum. This genus seems to be identical with that of Oestlund. Therefore, if following the priority we replace Siphonophora and Nectarophora by Macrosiphum, we should also reject the denomination of Macrosiphum for the

genus established by Del Guercio. I suggest therefore to replace this name by that of Nectarosiphon.

"In summary then we would have the following synonymy:

Macrosiphum Pass. (nec. Oestl., nec. Del G.)
Siphonophora C. Koch, Pass., etc.
Nectarophora Oestlund, etc.
Nectarosiphon n. nom.
Macrosiphum Del. G.
Macrosiphum Oestlund."

And finally (p. 113): "I have therefore replaced Macrosiphum Oestl., Del G. by Nectarosiphon and I think this change is well justified."

Hille Ris Lambers (1949) quoted only the underlined portion of Schouteden's remarks above, and concluded that Schouteden had replaced only Macrosiphum Del Guercio; Hille Ris Lambers then proposed the name Oestlundia to replace Macrosiphum Oestlund. If this were the case, the type of Macrosiphum Del G., convolvuli Kalt., would be the type of Nectarosiphon Schout.; otherwise, the genotype of the latter would be that of the older of the genera, viz., rubicola Oestl., the type of Macrosiphum Oestl.

Hille Ris Lambers (1946) stated that from Baker's (1920) work, convolvuli Kalt. is clearly Aphis persicae Sulz. which is then the genotype of Nectarosiphon Schout., which he places as a subgenus of Myzus Pass. MacGillivray (in Hille Ris Lambers and MacGillivray 1959) used this same line of reasoning. Although convolvuli Kalt. is generally held to be a synonym of persicae, Börner (1951) believed that the type of Macrosiphum Del Guercio was a misidentified specimen because

Del Guercio stated that the red spots on the base of the cornicles are typical characters of other aphids with long antennae, and this color clearly eliminates persicae.

Baker (1920), however, had placed convolvuli Kalt. in Amphorophora and listed Macrosiphum Oestl., Macrosiphum Del G., and Nectarosiphon Schout. as synonyms of that genus.

Börner (1951, 1952a) stated that Myzus Passerini is not available for persicae because persicae is the type of Myzodes Mord., and this genus is the type of another tribe of the Myzinae. However, this statement is relevant only in the light of Börner's (1952b) division of the subfamily Myzinae into several tribes, one, the Myzini, including Myzus Pass., and another, the Phorodontini, including Myzodes Mord. Although the character, presence or absence of spines on the hind tibia of first instar nymphs, separates the 2 tribes for European species, it cannot be applied to the Oriental fauna and therefore cannot be used indiscriminantly for generic separation (van Emden et al. 1969). Furthermore, since Myzodes is not the type genus of the Phorodontini, the assignment of persicae is not dependent upon a recognition of these 2 tribes of Myzinae.

I believe after a consideration of Schouteden's (1901) complete paper that he did replace both Macrosiphum Oestl. and Macrosiphum Del G. with his genus Nectarosiphon. Therefore, Macrosiphum Oestl., Nectarosiphon Schout. and Oestlundia Hille Ris Lambers are synonyms of Amphorophora Buckton.

The problems in Börner's (1952b) system of classification are further complicated by Shaposhnikov (1964) who included portulacae Macch. (= ornatus Laing), a species with spines on the hind tibiae of first instar nymphs, in the genus Myzodes. He based this on the number and arrangement of "rostral" setae on that segment, which in Myzus are 6 or 7 with the dorsal and ventral ones separated from the rest; but, in Myzodes they are either absent or are 5 in number and the distance between them equal. Börner (1952b) placed portulacae in Myzus Pass. but Aizenberg (1966) placed it as the type of his new genus Neomyzodes, differing from Myzodes Mord. in antennal tubercles parallel rather than converging, cornicles not swollen, antennae only about 1/2 the length of the body (rather than 3/4) and the hind tibia of first instar nymphs with spines between the setae, and differing from Myzus Pass. in the structure of the forehead, first tarsal segment of early nymphs with only 2 setae and 3 in adults and the absence of lateral and spinal tubercles.

The chaetotaxy of aphid nymphs has not yet been shown to have phylogenetic significance. Richards (1965) developed an evolutionary sequence in the Callaphidini utilizing setal patterns on the dorsum of adults; however, his system is much more complete than that proposed by Börner (1952b). It is true that the first instar nymphs of persicae differ from those of cerasi in the setation of the hind tibiae. However, the erection of a new genus based on this character allows

one to establish a new genus for every species which differs from the genotype; and, thus ignoring variation which occurs during the evolution of each genus due to the varying selective pressures imposed on each species depending on its ecological relationships.

The real problem is the phylogeny of the Myzini. Aizenberg (1966) states that Myzodes and Neomyzodes are derived from Myzus, as are all of the Myzinae. Therefore, to place persicae and ornatus in Myzus Pass. does not make this genus polyphyletic, the primary consideration of all systematics.

I believe that persicae is properly classified in the genus Myzus Pass. despite the differences which have been discussed and have done so in this paper without subgeneric designation and thus obviate the use of the names Nectarosiphon and Myzodes.

Characteristics. Antennal tubercles moderately to very prominent, converging, scabrous. Medial side of antennal segment I, and occasionally also II, scabrous. Alate viviparae with secondary sensoria in a more or less straight line only on antennal segment III, rarely with sensoria scattered over segment III and also present on IV (oliveri). Apterous viviparae without secondary sensoria. Rostral segment III with 2 pairs of lateral setae. Setal formula of first tarsal segments 3:3:3 or 3:3:2. Alate viviparae with a dorsal sclerotic patch on the abdomen, rarely absent (hemerocallis). Lateral abdominal tubercles frequently present on segments II-IV, rarely on I and V. Dorsal tubercles frequently present

on VII or VIII, or both. Cornicles cylindrical or swollen, always without an apical reticulated portion. Cauda usually conical and without constriction, rarely with apex knob-like (hemerocallis).

Type. Aphis cerasi Fabricius.
Distribution. Worldwide.

Key to Eastern U.S. Species of Myzus

1. First hind tarsal segment with 2 apical setae..... 2
   First hind tarsal segment with 3 apical setae..... 6
2. Cornicles swollen..... 3
   Cornicles cylindrical..... 5
3. Alate viviparae with sensoria on antennal segment III in a more or less straight line, rarely with 1-4 also present on IV; wing veins not bordered; apterous viviparae with antennal tubercles only moderately converging and cauda elongated and conical..... 4
   Alate viviparae with numerous sensoria scattered over segment III and 11-16 on IV; wing veins with conspicuous fuscous borders; apterous viviparae with antennal tubercles strongly converging and cauda subtriangular.....oliveri
4. Living color yellow to green; apical rostral segment with 2-3 lateral setae, rarely with 4; alate viviparae never with sensoria on antennal segment IV; cornicles of apterae pale or, if dark, only in the region of the apical flange; terminal filament of summer apterous viviparae at least 3 times the length of the base of antennal segment VI; males alate .....persicae (in part)
   Living color pink to brown; apical rostral segment with 2 pairs of lateral setae, rarely with only 3 setae; alate viviparae occasionally with sensoria on antennal segment IV; cornicles of apterae dark; terminal filament of summer apterous viviparae subequal to twice the length of the base of antennal segment VI; males apterous..... certus
5. Apices of antennal segments IV and V in alatae and III-V in apterae dark with the rest of the segments pale; abdominal tubercles absent.....varians

Antennal segments IV and V in alatae wholly dark; III and IV in apterae wholly pale, V wholly pale or with basal 1/2 pale and apical 1/2 dark; abdominal tubercles usually present, laterally on segments II-IV and dorsally on VIII, occasionally also on VII.persicae (in part)

6. Cauda conical, without constriction (Fig. 2F, I) abdomen of alate viviparae with dorsal sclerotic patch..... 7

Cauda with median constriction, apex knob-like (Fig. 2C) abdomen of alate viviparae without a dorsal sclerotic patch.....hemerocallis

7. One of the lateral accessory sensoria on the base of antennal segment VI much larger than the others and subequal in size to the primary sensorium (Fig. 2C)..... 8

All of the lateral accessory sensoria on the base of antennal segment VI subequal in size and much smaller than the primary sensorium.....ornatus

8. Living color brown to black; dorsal sclerotic patch on the abdomen of alate viviparae continuous laterally, or nearly so, with the lateral sclerites (Fig. 2B); dorsum of the abdomen of apterous viviparae sclerotic, pigmented; cauda elongated and conical.....cerasi

Living color green; dorsal sclerotic patch on the abdomen of alate viviparae rectangular, on the mid-dorsum and not extending laterally (Fig. 3I); dorsum of the abdomen of apterous viviparae membranous, not pigmented; cauda subtriangular.....lythri

Myzus cerasi (Fabricus)

Figure 2

Aphis cerasi Fabricius 1775:734.
Aphis aparines Kaltenbach 1843:46.
Aphis asperulae Walker 1848:2248.
Aphis euphrasiae Walker 1849: appendix 51.
Myzus cerasi (Fabricius). Passerini 1860:27.
Myzoides cerasi (Fabricius). van der Goot 1913:84.
Myzus quasipyrinus Theobald 1929:337.

FUNDATRIX (after Mason 1940). Coloration. General color of living specimens dark brown to black. General color of mounted specimens dark brown. Base of antennal segment III light; rest of antennae dark. Abdomen with dark lateral patches. Rest of specimen dark brown.

Morphology. Antennae shorter than body, 5-segmented; secondary sensoria absent. Lengths of antennal segments: III, 0.29-0.38; IV, 0.14-0.21; V, 0.10-0.14 + 0.14-0.18. Head width through eyes 0.39-0.46. Rostrum reaches hind coxae. Cornicles 0.35-0.46 long, cylindrical, slightly curved, heavily imbricated throughout. Cauda 0.14-0.21 long, conical, not constricted, with 2 pairs of lateral setae.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens dark brown. General body color of mounted specimens dark amber. Base of antennal segment III pale brown; rest of antennae and head dark brown. Dorsal patch on abdomen dark brown on a pale background; lateral sclerites dark brown. Cornicles, cauda, and anal and genital plates brown to dark brown.

Morphology. Body length 1.19-2.00. Antennal tubercles very prominent, converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae 6-segmented, subequal to body length, with 12-20 sensoria on segment III in a more or less straight line; segment VI with 1 lateral accessory sensorium subequal in size to primary sensorium. Lengths of antennal segments: III, 0.33-0.49; IV, 0.21-0.31; V, 0.17-0.26; VI, 0.10-0.15 + 0.34-0.54. Head width through eyes 0.30-0.44. Rostrum reaches hind coxae; apical segment 0.106-0.112 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment

0.079-0.101 long. Dorsal patch on abdomen on segments II-V; dorsal patch on VI-VII continuous with postsiphuncular sclerites. Lateral tubercles usually present on segments II-IV, frequently on I, and sometimes on V. Dorsal tubercles usually on VII and occasionally also on VIII. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.26-0.42 long, cylindrical, moderately imbricated. Cauda 0.12-0.17 long, elongated and conical, not constricted, with 4-9 lateral setae. Anal plate with 14-18 setae evenly distributed. Genital plate with 2 setae anteriorly and 11-13 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens dark brown to black. General color of mounted specimens dark brown to black. Head and antennal segments I and II dark brown; III, IV, and base of V pale to light brown; apex of V and VI black. Abdomen black. Cornicles black. Cauda and anal and genital plates dark brown.

Morphology. Body length 1.54-2.40. Antennal tubercles very prominent, strongly converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae 6-segmented, shorter than body; secondary sensoria absent. Lengths of antennal segments: III, 0.26-0.55; IV, 0.18-0.38; V, 0.16-0.26; VI, 0.10-0.16 + 0.32-0.49. Head width through eyes 0.41-0.51. Rostrum reaches hind coxae; apical segment 0.126-0.135 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs, rarely with an additional lateral seta. Second hind tarsal segment 0.090-0.117

long. Abdomen with lateral tubercles frequently on segments I-IV, rarely on V; dorsal tubercles usually on VII, rarely on VIII. Cornicles 0.36-0.60 long, cylindrical, curved, strongly imbricated. Cauda 0.10-0.20 long, elongated and conical, not constricted, with 6-10 lateral setae. Setae on anal and genital plates as in alate viviparae.

MALE. Generally similar to alate viviparous female. Antennal segment III with 54-60 scattered sensoria, IV with 20-21, V with 11 in addition to the primary sensorium at the distal end. Cauda 0.10 long, triangular, with 4 apical setae.

OVIPAROUS FEMALE. Essentially the same as the apterous viviparous female. Lengths of antennal segments: III, 0.19-0.20; IV, 0.13-0.14; V, 0.14; VI, 0.09 + 0.21. Hind tibiae slightly swollen with 44-49 pseudosensoria scattered over the middle 2/3 of the segment.

Types. Location of Fabricius' types unknown. Types of asperulae Walker, euphrasiae Walker, and quasipyrinus Theobald in the British Museum.

Distribution. Holarctic and Australian. Eastern U.S.: Maine to North Carolina and westward to the Mississippi River.

Collections studied. MAINE: Caribou, 24 June 1954 (W.A.S., G.W.S.), Prunus nigra Ait.; Veazie, 15 Aug. 1959 (C.F. Smith), Prunus sp. NEW HAMPSHIRE: Durham, 5 June 1923 (P.R. Lowry), cherry. MASSACHUSETTS: Boston, 6 July 1921 (H. Morrison), Prunus sp. and Japanese flowering cherry; 22 July 1921 (H. Morrison), Rubus ursinus (= vitifolius Cham.

and Schlecht.); Dedham, 3 Aug. 1917 (Mosher), cherry; Melrose, 11 Sept. 1917 (Mosher), chokecherry. NEW YORK: Babylon, 5 June 1939 (F. S. Blanton), cherry; 13 June 1939 (E. Kurz), cherry; Columbia Co., 11 June 1940 (Turner), cherry; Ithaca, 27 June 1939 (T. R. Hansberry), Prunus avium L.; 19 June 1952 (Kerr), near potato fields; Mattituck, 9 June 1961 (Latham), Lonicera sempervirens L. MICHIGAN: Fernville, 26 May 1911, sweet cherry; Grand Haven, 15 June 1936 (L. G. Strom), Prunus sp.; Keeler, 15 July 1946 (J. K. Karlovic). WISCONSIN: Milwaukee, 3 June 1932 (L. G. Strom), Prunus domestica L.: 16 Oct. 1934 (L. G. Strom), Prunus avium L.; Starts, 20 June 1947 (T. Andre), potatoes. NEW JERSEY: Trenton, 4 June 1888, cherry; Wenonah, 26 June 1907. PENNSYLVANIA: Carlisle, 6 June 1929 (E. D. Eaton), oxheart cherry; Harrisburg, 16 May 1905; Philadelphia, 5 July 1927 (W. Moffitt), cherry; Quincy, 20 May 1932 (J. O. Pepper), peach; Reading, 2 June 1941 (J. O. Pepper), cherry; Scotland, 21 May 1932 (J. O. Pepper), peach; State College, 4 Sept. 1940 (J. O. Pepper), wild cherry; 16 July 1961 (J. O. Pepper), sweeping Camaedaphne calyculata Moench.; York, 26 June 1894, cherry; 14 May 1942 (J. O. Pepper), sour cherry. OHIO: Columbus, 25 May 1897, cherry; 21 May 1925 (A. N. Tissot), cherry; 9 June 1958 (F. W. Mead), Prunus sp.; 20 June 1958, same data; Mowrystown, 25 May 1941 (A. N. Tissot), sour cherry. INDIANA: Indianapolis, 14 June 1911 (H. Morrison), cherry; 12 June 1912, same data. ILLINOIS:

Jerseyville, 25 June 1929 (Hottes and Frison), cherry; Mt. Carmel, 26 May 1928 (Hottes and Frison), peach; Oregora, 28 June 1928 (Hottes and Frison), cherry. WASHINGTON, D.C.: 16 June 1916, cherry; 4 June 1917, cherry. MARYLAND: Arundel, 23 May 1906; Baltimore, 22 June 1927, cherry. VIRGINIA: Chatham, 22 May 1942, cherry; Pulaski, 13 June 1916 (J. F. Strauss), cherry; Vienna, May 1913 (A. C. Baker), cherry, 29 Oct. 1915, same data. NORTH CAROLINA: Boone, 15 Oct. 1963 (C. E. Smith), Prunus sp.; Durham, 4 Apr. 1964, same data; Laurel Springs, 9 June 1960 (Smith and Tuatay), sweet cherry; 2 June 1961 (C. F. Smith), cherry; Smoky Mountain National Park, 30 June 1942 (C. F. Smith), Prunus pennsylvanica L. f.; Watauga Co., 8 Aug. 1961 (J. Graham), Prunus sp. TENNESSEE: Hamilton Co., 22 May 1939 (F. Turner), cherry; Roane Co., 26 May 1937, same data; Sullivan Co., 7 June 1939, same data. UTAH: Brigham, 5 May 1959 (G. F. Knowlton), sweet cherry; Providence 5 June 1963 (W. J. Hanson), sour cherry; Salt Lake City, 13 May 1961 (C. Nelson), cherry; 2 June 1961, same data. BRITISH COLUMBIA: Creston, 4 Aug. 1959 (W. H. A. Widdle and D. McComb), cherry. OREGON: Cornelius, 24 May 1936, cherry; Corvallis, 25 July 1938 (T. Y. Hsiao), cherry. CALIFORNIA: Berkeley, 12 May 1916 (E. O. Essig). USNM, FSCA, CFS, HBB, JOP.

Biology. This species overwinters as eggs on Prunus spp. The fundatrices hatch in late May and alate fundatrigeniae appear in late June - early July. Remigration

and mating occurs in September-October. This species frequently spends the entire year on its Prunus host without migration to any secondary hosts (Gillette and Taylor 1908).

Distinguishing characteristics. One of the lateral accessory sensoria on antennal segment VI subequal in size to the primary sensorium. Body color dark brown to black.

This species is very similar to Myzus lythri (Schrank), which also has 1 large accessory sensorium on antennal segment VI. However, the latter is green in color and has the dorsal abdominal patch confined to the middle of the abdomen, rather than extending to the lateral sclerites.

Myzus hemerocallis Takahashi

Figure 3, A-G

Myzus hemerocallis Takahashi 1921:24.
Myzus hemerocallidis Takahashi 1931:69.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens green. General color of mounted specimens light amber. Head brown, antennae light amber. Femur yellow; tibia yellow, its apex and tarsus brown. Abdomen pale, without a dorsal patch. Cornicles, cauda, and anal and genital plates yellow to yellowish brown.

Morphology. Body length 1.82-2.06. Antennal tubercles moderately prominent, converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae shorter than body, with 3-12 sensoria in a straight line on segment III. Lengths of antennal segments: III, 0.34-0.48; IV, 0.20-0.32; V, 0.14-0.20; VI, 0.09-0.12 + 0.29-0.32. Head

Figure 2.--Myzus cerasi (Fab.). A-F, alate viviparous female: A, head and antennal segments I-III; B, sclerotic pattern on abdomen (1/2 scale); C, base of antennal segment VI (2 x scale); D, rostrum; E, cornicle; F, cauda; G-I, apterous viviparous female: G, head; H, cornicle; I, cauda; J-K, male: J, antennal segments III-V; K, cauda; L-O, oviparous female: L, head; M, hind tibia; N, cornicle; O, cauda.

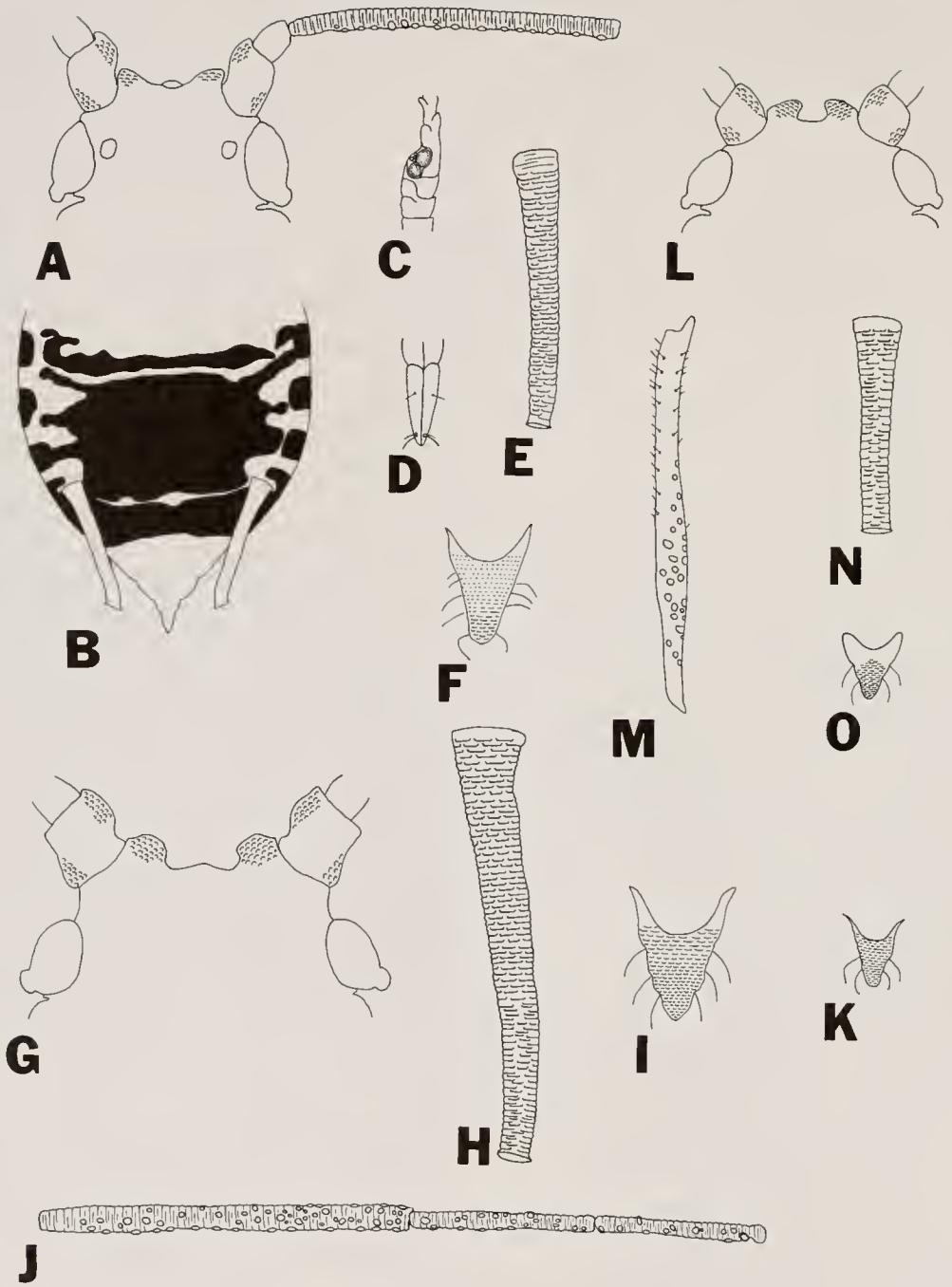

Figure 2

width through eyes 0.42-0.46. Rostrum reaches middle coxae; apical segment 0.101-0.119 long, with 2 pairs of lateral setae in addition to the usual 3 apical pairs. Setal formula of first trasal segments 3:3:3. Second hind tarsal segment 0.103-0.121 long. Abdominal tubercles absent. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.32-0.38 long, cylindrical, lightly imbricated throughout. Cauda 0.15-0.17 long, strongly constricted medially giving apex a knobbed appearance, with 3-5 lateral setae. Anal plate with 8-14 setae evenly distributed. Genital plate with 2 setae anteriorly and 12-14 along posterior edge, rarely with an additional seta either near the anterior edge or in the center of the plate.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens yellowish green. General color of mounted specimens yellow. Antennal segments V and VI brown, head and rest of antennae yellow. Femur yellow. Tibia yellow, its apex and tarsus brown. Abdomen pale. Cornicles, cauda, and anal and genital plates pale to yellow.

Morphology. Body length 1.80-2.30. Antennal tubercles moderately prominent, parallel to slightly converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae shorter than body, without secondary sensoria. Lengths of antennal segments: III, 0.21-0.36, IV, 0.12-0.22; V. 0.10-0.16; VI, 0.08-0.10 + 0.21-0.27. Head width through eyes 0.44-0.50. Rostrum surpasses middle coxae; apical segment 0.114-0.124 long, with 2 pairs of lateral setae in

addition to the usual 3 apical pairs. Second hind tarsal segment 0.094-0.130 long. Abdomen without sclerotic areas and tubercles. Segments I-V bilaterally, segmentally scaly in concentric patterns (Fig. 3E); segments VI-VIII transversely scaly. Cornicles 0.38-0.65 long, cylindrical, imbricated throughout. Cauda 0.15-0.19 long, with constriction as in alate viviparae, with 3-4 lateral setae and occasionally an additional subterminal seta. Setae on anal and genital plates as in alate viviparae.

Sexual forms are not known.

Types. In the Taihoku Agricultural Experiment Station, Taiwan.

Distribution. Oriental and Subtropical Nearctic. Eastern U. S.: Alabama, Florida, Louisiana.

Collections studied. ALABAMA: Pleasant Grove, 29 Apr. 1969 (F. F. Smith), Hemerocallis sp. FLORIDA: Gainesville, 6 Jan. 1958 (L. A. Hetrick), daylily; 17 Jan. 1960 (J. O. Pepper), daylily; 30 Jan. 1969 (A. N. Tissot), Hemerocallis fulva L.; 6 Mar. 1970 (R. J. Nielsson and D. Mays), daylily; Holly Hill, 10 Jan. 1964 (J. W. Pott), Liriope sp.; Jacksonville, 23 Jan. 1958 (R. L. King), Hemerocallis sp.; Orangedale, 6 Jan. 1958, same data; Tallahassee, 6 Feb. 1958 (R. H. Miller and K. P. Bragdon), Hemerocallis sp. LOUISIANA: Baton Rouge, 16 Feb. 1958 (L. D. Newsome), daylily; 22 Mar. 1958, same data; 20 Aug. 1960 (C. F. Smith), daylily; 4 Apr. 1969 (H. B. Boudreaux), daylily; 10 Apr. 1969, same data; Lafayette, 21 Mar. 1958 (L. D. Newsome), daylily. USNM, FSCA, CFS, HBB, JOP.

Figure 3.--Myzus hemerocallis Tak., A-G. A-C, alate viviparous female: A,head and antennal segments I-III; B, cornicle; C, cauda; D-G, apterous viviparous female: D, head, E, pattern of scales on abdomen (1/2 scale); F, cornicle; G, cauda. M. lythri (Schrk.), H-P. H-K, M, O, alate viviparous female: H, head and antennal segments I-III; I, sclerotic pattern on abdomen (1/2 scale); J, base of antennal segment VI (2 x scale); K, rostrum; M, cornicle; O, cauda; L,N,P, apterous viviparous female; L, head; N, cornicle; P, cauda.

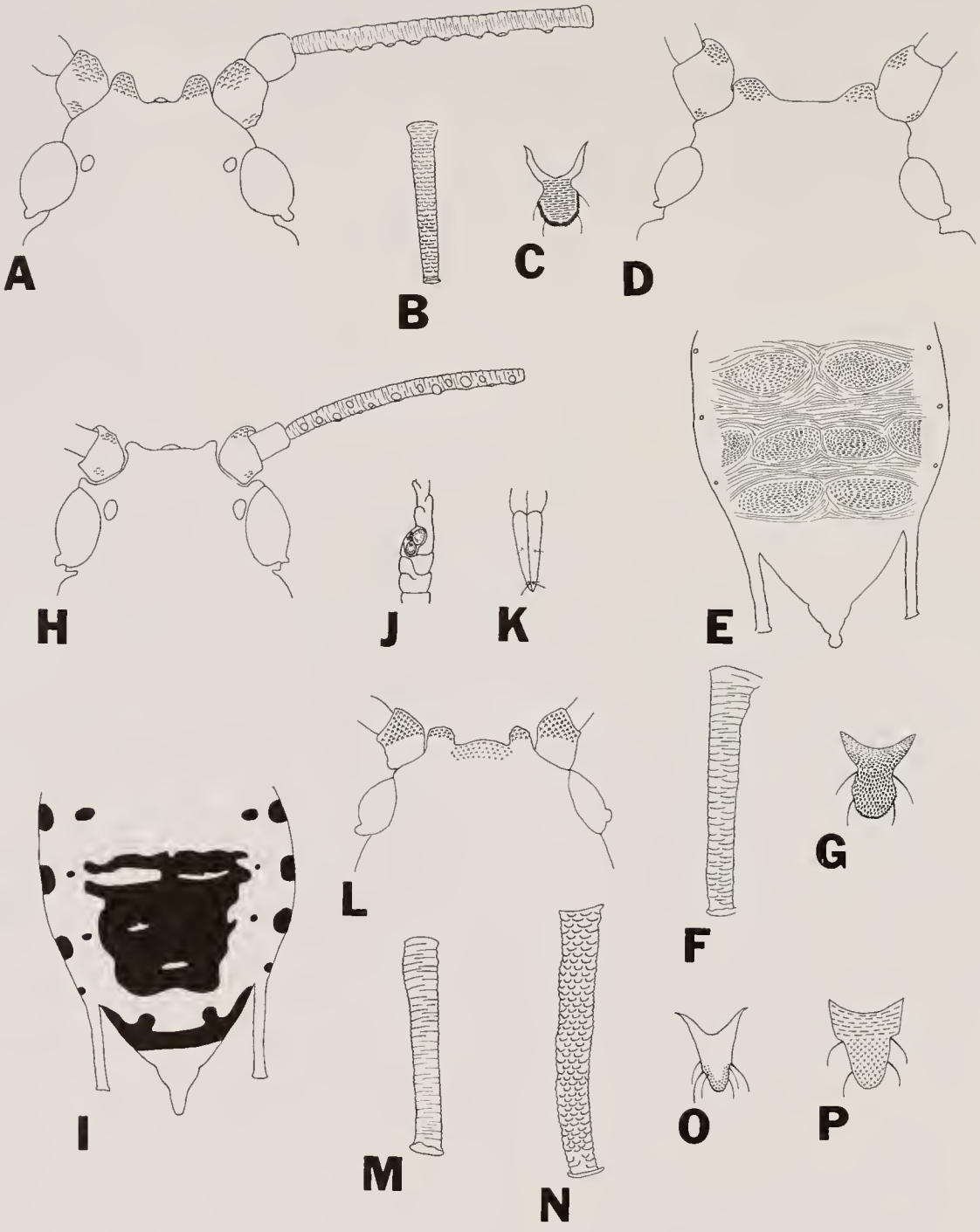

Figure 3

Biology. The biology of this species has yet to be investigated. It has only been collected on Hemerocallis spp. and might possibly be anholocyclic on that host. Aphids have been found on the roots of these plants from May to November (unpublished). Alternate hosts are not known.

Distinguishing characteristics. Abdomen of alatae without dorsal sclerotic patch. Abdomen of apterae with unusual scaly pattern as described above. Abdominal tubercles absent. Cauda with apex knob-like.

Myzus lythri (Schrank)

Figure 3, H-P

Aphis lythri Schrank 1801:115.
Aphis mahaleb Koch 1854:113.
Myzus lythri (Schrank). Passerini 1863-26. - Mason 1940: 13-4. - Heinze 1961:30.
Myzus mahaleb (Koch). Passerini 1863:26. - Gillette and Palmer 1934:203-4.
Phorodon humuli var. mahaleb (Koch). Buckton 1876:168.
Myzoides lythri (Schrank). van der Goot 1913:184.
Myzaphis lythri (Schrank). van der Goot 1915:184. - Nevsky 1929:153.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens green. General color of mounted specimens brownish amber. Base of antennal segment III pale; head and rest of antennae brownish amber. Basal 1/4 of femur pale, apex brown. Tibia pale to yellowish amber; apex and tarsus brown. Abdomen with brown central patch and lateral sclerites on a pale background. Cornicles, cauda, and anal and genital plates brown.

Morphology. Body length 1.22-2.01. Antennal tubercles not prominent, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae considerably shorter than body, with 10-19 sensoria in an irregular row on segment III; segment VI with one lateral sensorium subequal in size to the primary sensorium. Lengths of antennal segments: III, 0.31-0.45; IV, 0.16-0.28; V, 0.11-0.22; VI, 0.07-0.12 + 0.20-0.39. Head width through eyes 0.35-0.41. Rostrum reaches middle coxae; apical segment 0.108-0.126 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs, rarely with an additional lateral or surface seta. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.079-0.101 long. Abdomen with a rectangular central sclerite on segments III-V, lateral and pleural sclerites on II-IV, presiphuncular sclerite on V, and postsiphuncular sclerite on VI-VII which is partially connected to medial transverse patch on those segments. Lateral tubercles frequently on segments II-IV. Dorsal tubercles absent. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.25-0.40 long, cylindrical, weakly imbricated. Cauda 0.12-0.18 long, conical to subtriangular, slightly constricted medially, with 5-7, usually 6, lateral setae. Anal plate with 10-15 setae evenly distributed. Genital plate with 2 setae anteriorly, 1 or 2 smaller setae on the anterior edge or in the middle of the plate, and 14-19 along the posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens light green. General color of mounted specimens pale. Head and antennae pale; segment VI light amber. Femur yellow. Tibia yellow; its apex and tarsus amber. Abdomen without pigmented sclerites. Cornicles, cauda, and anal and genital plates yellow to light amber.

Morphology. Body length 1.33-1.99. Antennal tubercles moderately prominent, slightly converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae subequal to 1/2 the body length, secondary sensoria absent; segment VI with 1 lateral sensorium subequal in size to the primary sensorium. Lengths of antennal segments: III, 0.19-0.31; IV, 0.10-0.21; V, 0.09-0.16; VI, 0.06-0.10 0.15-0.28. Head width through eyes 0.35-0.46. Rostrum surpasses middle coxae; apical segment 0.090-0.137 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.072-0.104 long. Dorsal surface of abdomen sclerotic, rugose; pigmented areas absent. Cornicles 0.38-0.55 long, cylindrical, tapered and slightly curved, strongly imbricated. Cauda 0.13-0.20 long, conical, not constricted, with 4-7 lateral setae. Setae on anal and genital plates as in alate viviparae.

MALE. Generally similar to alate viviparous female. Antennal segment III with 29-43 scattered sensoria, IV with 14-18, and V with 7-8 in an irregular row in addition to the primary sensorium.

OVIPAROUS FEMALE. No specimens were available for study. Gillette and Palmer (1934) figure the hind tibia but do not discuss any of the morphological characters. According to Mason (1940), oviparae are similar to apterous viviparae, slightly darker. Cornicles are more slender and less curved than in apterae.

Types. Location unknown.

Distribution. Holarctic. Eastern U.S.: Widespread.

Collections studied. MAINE: Veazie, 15 Aug. 1959 (C. F. Smith), Prunus sp. NEW YORK: Ithaca, 21 July 1939 (T. R. Hansberry), Lythrum salicaria L.; Lockport, 4 June 1959 (L. L. Pechuman), Prunus mahaleb L.; Mt. Kisco, 22 Aug. 1960 (J. Graham), Lythrum salicaria L. MICHIGAN: LaSalle, 15 Sept. 1938 (L. J. Bottimer), Lythrum alatum Prush. PENNSYLVANIA: Huntingdon, 31 Aug. 1962 (J. O. Pepper), Ludwigia alternifolia L.; Springbrook, 17 July 1945 (Sailer), Amelanchier sp.; State College, 14 Jan. 1942 (J. O. Pepper), Prunus sp.; 31 May 1964 (J. O. Pepper), Prunus pennsylvanica L. f.; 7 June 1964 (J. O. Pepper), Prunus virginiana L. OHIO: Wooster, 16 May 1960 (R. Rings), Prunus mahaleb L. WASHINGTON, D.C.: 31 May 1916 (D. W.), pear; 4 Apr. 1917 (A. C. Baker), plum. NORTH CAROLINA: Blowing Rock, 29 Sept. 1961 (C. F. Smith), light trap; Blue Ridge Parkway, 29 Sept. 1961 (C. F. Smith), Epilobium sp.; Boone, 11 Sept. 1963 (Smith, Pepper and Tissot), Prunus sp.; 15 Oct. 1963 (C. F. Smith), Prunus sp.; Fletcher, 25 May 1960, light trap; Wilkesboro, 9 Sept. 1963 (Smith, Pepper and Tissot),

Epilobium sp. FLORIDA: Gainesville, 4 May 1937 (L. J. Bottimer and A. N. Tissot), Lythrum lineare L.; Otter Creek, 30 Apr. 1970 (A. N. Tissot and R. J. Nielsson), Lythrum sp.; Palmetto, 21 Mar. 1941 (A. N. Tissot), Lythrum lineare L.; Vero Beach, 19 Apr. 1944 (Light), Lythrum sp. USNM, FSCA, CFS.

Biology. This species alternates between the primary hosts Prunus spp. and the secondary hosts Epilobium spp. and Lythrum spp. There is no published seasonal history for lythri, but from the collection records it seems that primary viviparae migrate to secondary hosts in May - June and alate virginoparae remigrate in September - October. The species may also live throughout the year on its primary hosts.

Distinguishing characteristics. One lateral sensorium on segment VI subequal in size to the primary sensorium. Alate viviparae with a quadrangular medial dorsal patch on segments III-V. Dorsum of abdomen of apterae sclerotic, rugose, without pigmentation. Cauda conical to subtriangular.

This species is close to M. cerasi (Fab.). The means by which they can be separated are discussed under the latter species.

Myzus oliveri (Essig)

Figure 4, A-H; 5

Neotoxoptera violae Theobald 1915a:131. (junior homonym)
Micromyzus oliveri Essig 1935:160-2
Myzus (Neotoxoptera) oliveri (Essig). Eastop 1961:36 - 1966:465.

This species, with violae Pergande and formosanus Takahashi, had been placed in the genera Micromyzus (Essig 1935, 1936), Neotoxoptera (Theoblad 1915a, Pepper 1965), Fullawayella (Baker 1919, Takahashi 1921, Hardy 1931), or Idiopterus (Hottes and Frison 1931). Neotoxoptera, type violae Theobald, was generally considered to be only a variant of Micromyzus violae (Pergande). The genus Fullawayella is a synonym of Idiopterus, monotypic genus. This left only the genus Micromyzus for aphids with numerous sensoria on the antennal segments of alate viviparae, wing veins conspicuously bordered and abdomen with a dorsal sclerotic patch.

Neotoxoptera is closely related to Phordon while Micromyzus is tropical, with no known Palaearctic relatives and is generally restricted to ferns. Since this species lacks the finger-like projections on the antennal tubercles which are characteristic of Phorodon, it was placed in the genus Myzus, subgenus Neotoxoptera (Eastop 1961).

This species is considered here without subgeneric designation and is believed to be related to M. persicae.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens dark red to greenish black. General color of mounted specimens brown. Head and antennal segments I and II brown, rest of antennae pale. Wing veins brown with wide fuscous borders. Basal 1/3 of femur pale, apex brown, Tibia amber; its apex and tarsus dark brown.

Lateral sclerites and dorsal patch on the abdomen brown on a pale background. Cornicles, cauda, and anal and genital plates brown.

Morphology. Body length 1.18-1.97. Antennal tubercles very prominent, converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae longer than body, with 33-54 scattered sensoria on segment III, 11-27 on IV, and 0-7 in a straight line on V in addition to the primary sensorium. Lengths of antennal segments: III, 0.46-0.71; IV, 0.35-0.55; V, 0.29-0.41; VI; 0.13-0.16 + 0.44-0.59. Head width through eyes 0.35-0.44. Rostrum reaches middle coxae; apical segment 0.114-0.119 long, with 4-6 lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:2. Second hind tarsal segment 0.067-0.110 long. Abdomen with lateral sclerites on segments II-IV, presiphuncular sclerite on V, postsiphuncular sclerite on VI, dorsal patch with lateral extensions on III-VI and a median pigmented patch on VII. Segments VII and VIII transversely wrinkled laterally. Lateral tubercles sometimes on sclerites on segments III and IV, occasionally on II. Segment VII with 2 dorsal setae; VIII with 4. Cornicles 0.24-0.31 long, swollen, nearly smooth. Cauda 0.12-0.15 long, conical, blunt, not constricted, with 2-3 pairs of lateral setae and sometimes with an additional subterminal seta. Anal plate with 8-12 setae evenly distributed. Genital plate with 2 setae anteriorly and 6-11 along posterior edge, rarely with 1-2 additional setae in center of plate.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens brown. General color of mounted specimens yellowish amber. Head yellowish amber. Antennal segments I and II brown, III-V yellowish amber with apices darker, VI yellowish amber with a brown area around the primary sensorium. Basal 1/6 of femur pale, remainder amber. Tibia amber; its apex and tarsus brown. Abdomen pale. Cornicles, cauda, and anal and genital plates light yellowish amber.

Morphology. Body length 1.18-1.95. Antennal tubercles very prominent, strongly converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antenna longer than body, usually without secondary sensoria (1 specimen with 1 sensorium basally on segment III on 1 antenna and 3 on the other). Lengths of antennal segments: III, 0.43-0.65; IV, 0.32-0.51; V, 0.28-0.41; VI, 0.12-0.15 + 0.44-0.59. Head width through eyes 0.33-0.38. Rostrum surpasses middle coxae; apical segment 0.110-0.122 long. Abdomen without pigmented areas; segments VII and VIII strongly wrinkled transversely. Cornicles 0.26-0.30 long. Cauda 0.09-0.12 long. Other features as in alate viviparae.

Sexual forms are unknown.

Types. Location of types unknown.

Distribution. Nearctic, Ethiopian, Australian. Eastern U. S.: Widespread.

Collections studied. MASSACHUSETTS: Newton Centre, 29 Nov. 1898 (Pergande), violets. RHODE ISLAND: Providence,

9 Feb. 1900 (F. Roberts), violets. NEW YORK: Ithaca, Dec. 1923 (C. R. Crosby), onion; Long Island, 15 Oct. 1901 (Pergande), violets; Poughkeepsie, 14 Dec. 1898, same data. PENNSYLVANIA: Lemont, Apr. 1951 (J. O. Pepper), onion. MARYLAND: College Park, 15 Jan. 1928 (J. L. Hoerner), Viola sp. WASHINGTON, D. C.: 11 Nov. 1898 (Pergande), violets; 18 Nov. 1898, same data. VIRGINIA: Norfolk, 18 Apr. 1939 (L. D. Anderson), onion; Vienna, 30 Nov. 1901 (Pergande), Viola odorata L.; 4 May 1912 (A. C. Baker), violets; Apr. 1914, same data. NORTH CAROLINA: Anson Co., 15 Apr. 1939 (Turner), peach. TENNESSEE: Pleasant View, 23 May 1946 (L. B. Scott), tobacco. FLORIDA: Gainesville, 4 Feb. 1927 (A. N. Tissot), Valeriana scandens L.; 8 Feb. 1927 (A. N. Tissot), Viola sp.; 25 Feb. 1928 (A. N. Tissot), Valeriana scandens L. and Viola septemloba LeConte; 5 Mar. 1928 (A. N. Tissot), Valeriana scandens L. and Viola walteri House; 9 Feb. 1932 (E. West and A. N. Tissot), Valeriana scandens L. and Viola cucullata Ait.; 13 Feb. 1936 (A. N. Tissot), Valeriana scandens L.; 20 Feb. 1936, same data; 28 Apr. 1939 (A. N. Tissot), Viola sp.; 30 May 1939, same data; 15 Mar. 1940 (West, Arnold, and Tissot), Viola floridana Brainerd; 6 Apr. 1941 (A. N. Tissot), Stellaria media (L.) Vill.; Moultrie, 17 Feb. 1949 (W. G. Genung), Viola sp. ONTARIO: Toronto, 20 Oct. 1899 (Pergande), violets. KANSAS: Lawrence, 6 Nov. 1903 (C. E. Sanborn), Viola sp. CALIFORNIA: Arcadia, 22 Mar. 1969 (H. G. Walker),

Teucrium chanaedrys L.; 8 Apr. 1969 (H. G. Walker), Dianthus deltoides L.; 13 May 1969 (H. G. Walker), Cerastium tomentosum L.; 23 Oct. 1969, same data; 21 Nov. 1969 (H. G. Walker), Viola odorata L.; 13 Feb. 1970 (H. G. Walker), Cerastium tomentosum L.; 5 Nov. 1970, same data. USNM, FSCA, HGW, JOP.

Biology. The biology of this species has not been thoroughly studied. It apparently lives parthenogenetically throughout the year on its host plants (Eastop 1961).

The collection from Dianthus deltoides L., 8 Apr. 1969, Arcadia, Calif., contained both alates and apterae; the latter were normal but the alate viviparae had 7-10 sensoria in a straight line on antennal segment III, no secondary sensoria on segments IV and V and a very abnormal pattern of wing venation (Fig. 5 G-J, N-O). Eastop (1961) had observed similar forms and concluded that they were apteriform alatae.

Distinguishing characteristics. Alate viviparae with numberous sensoria on antennal segments III and IV and a few usually on V. Wing veins conspicuously bordered. Abdomen with a dorsal sclerotic patch.

Myzus ornatus Laing

Figure 4, I-Q

Myzus ornatus Laing 1932:52. - Essig 1938:92. -Essig 1947:611.
Myzus portulacae Macchiati 1883:235-6, in Heinze 1961:32.
Neomyzodes ornatus (Laing). Aizenberg 1966:148-9.

Figure 4.-- Myzus oliveri (Essig), A-H. A-D, alate viviparous female: A, head and antennal segments I-IV; B, sclerotic pattern on abdomen (1/2 scale); C, cornicle; D, cauda; E-H, apterous viviparous female: E,head; F, rostrum; G, cornicle; H, cauda. M. ornatus Laing, I-Q. I-M, alate viviparous female: I, head and antennal segments I-III; J, sclerotic pattern on abdomen (1/2 scale); K, rostrum; L, cornicle; M, cauda; N-Q, apterous viviparous female: N, head; O, sclerotic pattern on abdomen (1/2 scale); P, cornicle; Q, cauda.

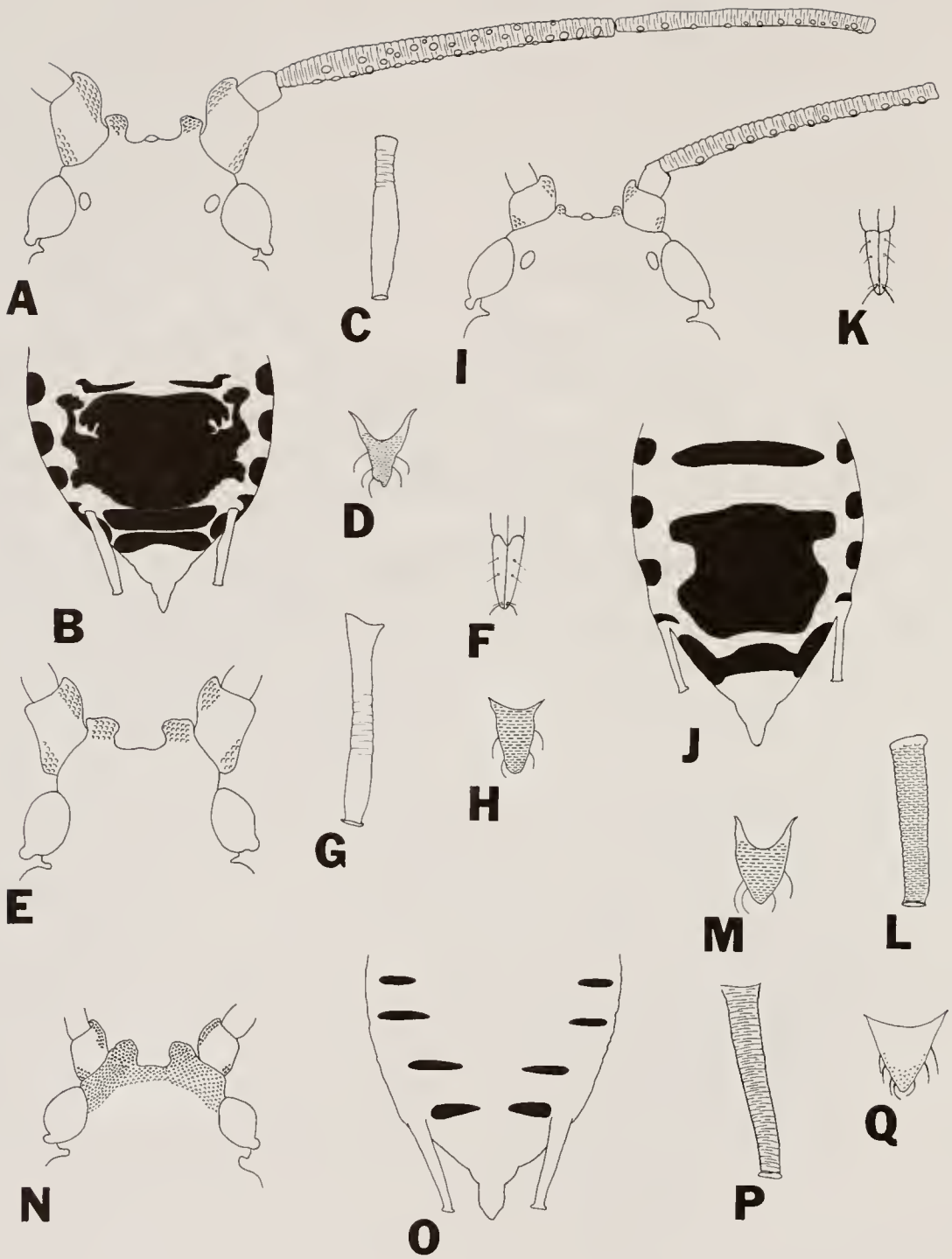

Figure 4

Figure 5.--Variation in wing venation in Myzus oliveri (Essig). A-J, forewings, K-O, hindwings; A, B, and K typical. A-F and K-M normal; G-J and N-O from apteriform alatae.

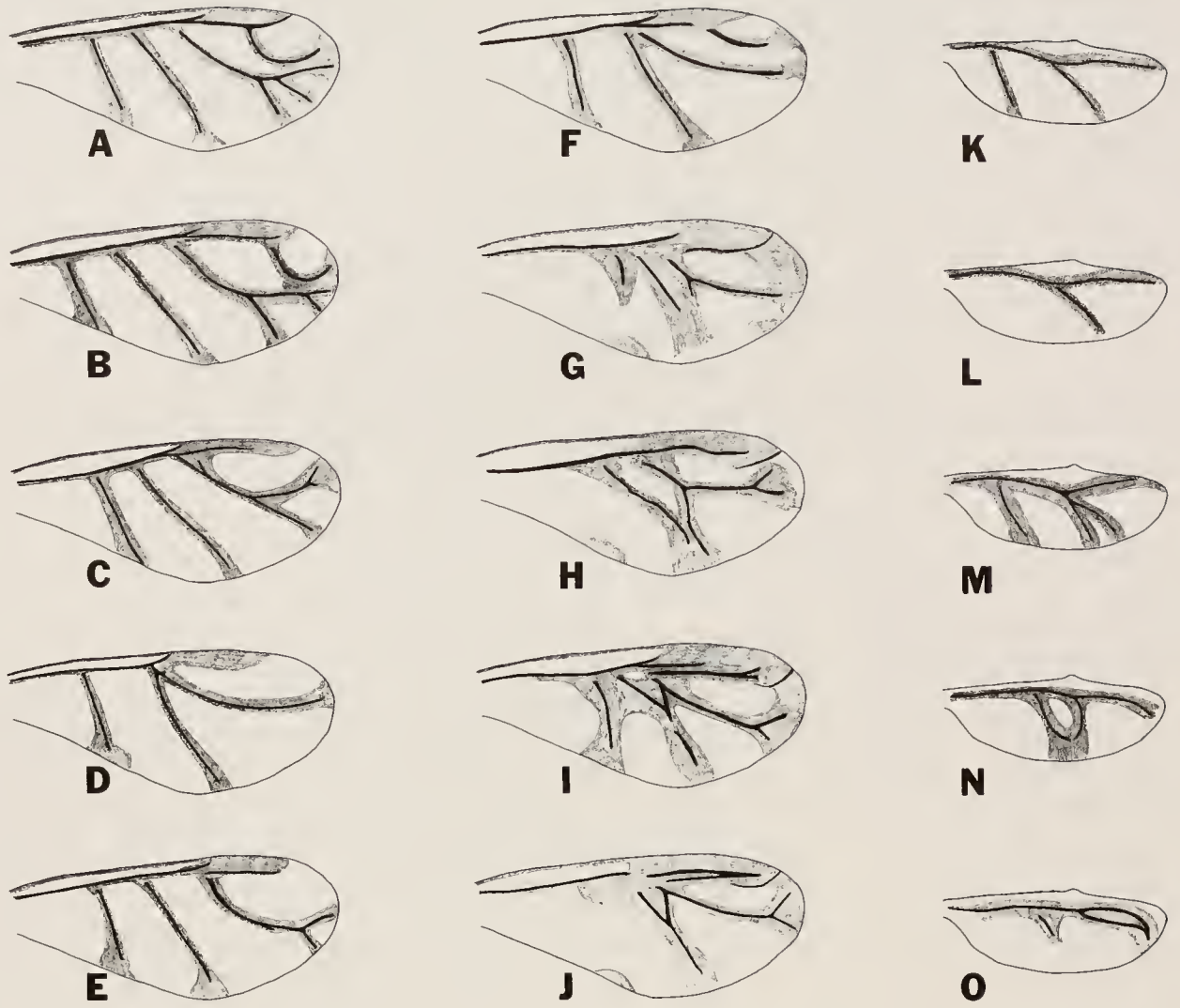

Figure 5

Heinze (1961) considered ornatus Laing and portulacae Macch. to be the same species and the latter, due to priority, would then be the correct name. I examined a translation of Macchiati's description, which is in Italian and unfortunately is too brief and without figures. No specimens were available for study so that an accurate judgment of this synonomy cannot be made. However, since Heinze's work is the first published record of this name since the original description, as far as I am able to determine, I declare Myzus portulacae Macchiati to be a nomen oblitum by virtue of Art. 23, Sect. b of the International Code of Zoological Nomenclature (50-year rule), and therefore designate Myzus ornatus Laing as the valid name for this species.

Aizenberg (1966) placed ornatus Laing as the type of his new genus Neomyzodes, differing from Myzus, in which it had been placed by Börner (1952b), in the structure of the vertex, first hind tarsal segment with only 2 setae in early nymphs and 3 in adults and the absence of abdominal tubercles. From Myzodes it differs in antennal tubercles less developed and more parallel, antennae only about 1/2 the body length (rather than more than 3/4) and hind tibiae of first instar nymphs with spines between the setae. I consider Aizenberg's

genus to be based on evolutionary differences of a minor magnitude and therefore retain ornatus in the genus Myzus Pass.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens dark green. General body color of mounted specimens brownish amber. Head brown. Base of antennal segment III pale, rest of antennae amber. Basal 1/4-1/3 of femur pale, its apex dark brown. Tibia yellowish amber, its apex and tarsus brown. Central abdominal sclerite and lateral sclerites brown on a pale background. Cornicles, cauda, and anal and genital plates amber-brown.

Morphology. Body length 1.19-1.50. Antennal tubercles not prominent, parallel to slightly converging, weakly scabrous. Setae on head and antennae pointed, inconspicuous. Antennae shorter than body, with 4-8 sensoria in a straight row on segment III. Lengths of antennal segments: III, 0.34-0.37; IV, 0.24-0.25; V, 0.18-0.20; VI, 0.10-0.13 + 0.23-0.27. Head width through eyes 0.30-0.31. Rostrum not reaching middle coxae; apical segment 0.074 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.072-0.079 long. Abdomen with an irregular central sclerotic area on segments III-V, a row of pleural spots on each side on I-IV, large lateral sclerites on II-IV, presiphuncular sclerite on V, and well-developed postsiphuncular sclerite on VI-VII. Abdominal tubercles absent. Segments VII and VIII each with 2 dorsal

setae. Cornicles 0.21-0.23 long,cylindrical, slightly tapered, moderately imbricated. Cauda 0.13 long, conical, not constricted, with 5-7 lateral setae. Anal plate with 12-14 setae evenly distributed. Genital plate with 2 setae anteriorly and 8-10 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens green. General body color of mounted specimens pale to yellow. Antennal segment VI light amber, head and rest of antennae yellow. Legs yellow; apex of tibia and tarsus amber. Abdomen pale with brown markings. Cornicles, cauda, and anal and genital plates yellow.

Morphology. Body length 1.12-1.45. Antennal tubercles not very prominent, slightly converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae subequal to 1/2 the body length; secondary sensoria absent. Lengths of antennal segments; III, 0.20-0.25; IV, 0.13-0.16; V, 0.11-0.13; VI, 0.07-0.09 + 0.17-0.20. Head width through eyes 0.29-0.35. Rostrum surpasses hind coxae; apical segment 0.090-0.097 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.068-0.079 long. Dorsal surface of abdomen sclerotic, wrinkled, with transversely elongated pigmented patches dorsolaterally on segments I-VI and with transverse rows of pigmented spots medially on V and VI. Cornicles 0.26-0.30 long, cylindrical, tapered, moderately imbricated. Cauda 0.11-0.14 long, conical with obtuse apex, not constricted, with 4-6 lateral setae. Setae on anal and genital plates as in alate viviparae.

Sexual forms are not known.

Types. In the British Museum. Paratypes in the USNM.

Distribution. Holarctic. Eastern U.S.: Widespread.

Collections studied. I studied specimens collected from Maine to Florida and because the species is so polyphagous, I have reduced the collection records to a list of plants, by families, on which it was collected; presumably many of these collections were on greenhouse plants. AMARANTHACEAE: Achyrantes sp., Celosia sp.; ARACEAE: Dieffenbacchia sp.; ARMERIACEAE: Limonium sp.; BALSAMINACEAE: Impatiens sp.; BEGONIACEAE: Begonia sp.; BORAGINACEAE: Anchusa sp.; CARYOPHYLLACEAE: Dianthus caryophyllus L., Myosotis sp.; CELASTRACEAE: Euonymous sp.; CISTACEAE: Helianthemum sp.; COMMELINACEAE: Tradescantia sp.; COMPOSITAE: Anacyclus sp., Artemisia vulgaris L., Aster sp., Bellis sp., Bidens bipinnata L., Chrysanthemum leucanthemum L., Chrysanthemum sp., Cineraria sp., Eupatorium glandulosum HBK, E. riparium Regel, Gaillardia picta Gray var. lorenziana Hort., Gazania sp., Helianthus anuus L., Mutisia sp., Parthenium sp., Senecio sp., Sonchus asper (L.) All., Sonchus sp.; CRASSULACEAE: Sedum sp.; CRUCIFERAE: cabbage - Brassica oleracea L., cauliflower - B. oleracea botrytis DC, Hutchinsia sp., horseradish - Roripa armoracia A. Hitchc., Teesdalia nudicaulis (L.) R. Br.; CUCURBITACEAE: Cucurbita sp., Echinocystis sp.; ERICACEAE: Azalea procumbens L., Azalea sp., heather - Calluna vulgaris (L.) Hull, heath -

Erica sp.; EUPHORBIACEAE: Croton sp.; GENTIANACEAE: Gentiana acaulis L., Gentiana sp.; GESNERIACEAE: Gloxinia sp., Saintpaulia sp.; GRAMINAE: barley - Hordeum sp.; HEDERACEAE: Hedera helix L.; JUNIPERACEAE: Juniperus sp.; LABIATAE: Coleus sp., Lavandula sp., Mentha sp., Salvia azurea Lam., S. greggii A. Gray, S. mellifera Hort., S. microphylla Hort., Teucrium chamaedrys L., T. scorodonia L., thyme - Thymus serphyllum L.; LEGUMINOSAE: Lathyrus sp., shamrock - Trifolium dubium Sibth., Trifolium sp.; LILIACEAE: garlic - Allium muscari L., Convallaria sp., Heloniopsis breviscapa Maxim.; MALVACEAE: Malvaviscus sp.; MORINACEAE: Dipsacus fullonum L.; ONAGRACEAE: Fuchsia sp.; ORCHIDACEAE: Bletia sp., Cymbidium sp.; PAPAVERACEAE: Dicentra spectabilis Lem.; PITTOSPORACEAE: Pittosporum sp.; POLYGONNACEAE: sorrel - Rumex acetosella L., R. obtusifolius L.; PRIMULACEAE: Androsace lanuginosa Wall., Cyclamen sp., Primula sp., Ramondia sp.; RANUNCULACEAE: Clematis seiboldii D. Don., Helleborus sp.; ROSACEAE: Contoneaster pyracantha (L.) Spach., Fragaria sp., Potentilla sp., Rosa sp., Spiraea sp.; RUBIACEAE: Gardenia sp.; SAXIFRAGACEAE: Hydrangea sp., Saxifraga sp.; SCROPHULARIACEAE: Mazus pumilo R. Br., Veronica sp.; SOLANACEAE: potato - Solanum tuberosum L.; THEACEAE: Camellia sp.; ULMACEAE: Ulmus campestris L., Zelkova sp.; UMBELLIFERAE: celery - Apium graveolens L., Azorella sp., parsley - Petroselinum crispum (Mill.) Mansf.; Valeriana sp.; VERBENACEAE: Duranta plumieri Jacq., Duranta sp., Lantana camara L.; VIOLACEAE: Viola sp. USNM, FSCA, CFS, JOP, HCW.

Biology. This species lives parthenogenetically throughout the year on plants in greenhouses and, in subtropical climates, in the field. Alates are only occasionally produced and sexual forms are not known.

Distinguishing characteristics. Abdominal tubercles absent. Apterae with a bilateral series of transversely elongate pigmented patches located pleurally on the abdomen.

Myzus persicae (Sulzer)

Figure 6, A-L

Aphis persicae Sulzer 1776: 105.
Aphis dianthi Schrank 1801: 114.
Aphis vulgaris Kyber 1815: 9.
Aphis furcipes Rafinesque 1817: 361, in Hottes 1931: 63.
Cinara raphani Mosley 1841: 747-8.
Aphis rapae Curtis 1842: 53.
Aphis dubia Curtis 1842: 54.
Aphis convolvuli Kaltenbach 1843: 40-1.
Aphis vastator Smee 1846: 137, in Meier 1954: 348.
Aphis cynoglossi Walker 1848: 2217.
Aphis particeps Walker 1848: 2217.
Aphis sodalis Walker 1848: 2217.
Aphis persola Walker 1848: 2246.
Aphis redundans Walker 1849: 32.
Aphis aucta Walker 1849: 33 in part.
Aphis egressa Walker 1849: 38.
Aphis malvae Walker 1849: 47.
Aphis bartsiae Walker 1849: 49.
Aphis derelicta Walker 1849: 50.
Rhopalosiphum dianthi (Schrank), Koch 1854: 55-6. -- Williams 1910: 69 in part.
Aphis persicophila Passerini 1860: 36.
Rhopalosiphum persicae (Sulzer), Passerini 1863: 20.
Aphis persicaecola Boisduval 1867: 251.
Myzus persicae (Sulzer), Buckton 1877: 178-80. -- Gillette and Palmer 1934: 204-6.
Siphonophora achyrantes Monell 1879: 18-9.
Siphonophora calendulella Monell 1879: 19.
Siphonophora antirrhinii Macchiati 1883: 228.
Myzus malvae Oestlund 1886: 31-32
Myzus achyrantes (Monell), Oestlund 1887: 74.
Macrosiphum convolvuli (Kalt.), Del Guercio 1900: 159.
Myzus pergandii Sanderson 1901: 72-3.
Rhopalosiphum tulipae Davidson 1910: 377.

Rhopalosiphum dianthi poae Williams 1910: 70.
Phorodon cynoglossi Williams 1911: 172-3.
Rhopalosiphum solani Theobald 1912: 165-9.
Rhopalosiphum betae Theobald 1913: 918, in Meier 1954: 349.
Macrosiphum betae (Theobald), Theobald 1913: 153.
Macrosiphum antirrhinii (Macchiati), Theobald 1913: 157.
Myzoides persicae (Sulzer), van der Goot 1913: 84. -- van der Goot 1915: 170. -- 1917: 48.
Myzodes tabaci Mordwilko 1914: 52.
Rhopalosiphum lactucellum Theobald 1915: 115.
Myzus godetiae Shinji 1917: 49-50.
Rhopalosiphum solanella Theobald 1918: 12, in Meier 1954:349.
Rhopalosiphum tuberosellae Theobald 1919: 161.
Myzus tuberosellae (Theobald), Theobald 1922: 1.
Myzus impactus Theobald 1926: 342-3 in part.
Rhopalosiphoninus dianthi (Schrank), Börner 1926: 228.
Myzodes persicae (Sulzer), Mordwilko 1928: 192. -- Börner 1951: 101-11. -- Börner 1952a: 122-7. -- Heinze 1960: 841.
Phorodon (Myzodes) persicae (Sulzer), Börner 1930: 139.
Myzus (Nectarosiphon) persicae (Sulzer), Hille Ris Lambers 1946: 197. -- 1952a: 119-21.

This long list of synonyms is due to the very polyphagous habit of the species and to its wide distribution. Schrank (1801) described Aphis dianthi from carnation. In Europe there is an anholocyclic strain of persicae on carnation (Hille Ris Lambers 1966) which is sometimes given subspecific status. However, the dianthi of most authors is not from carnation and therefore refers to persicae s.s., or, if from carnation, are actually records for Myzus certus (Walker), a close relative of persicae, which does damage carnation. I have examined specimens from carnation which were persicae; therefore I know that persicae can be found on this host, but it causes little or no damage and cannot propagate continuously on this host.

The question of Myzodes and Nectarosiphon was taken up under the generic discussion. Börner (1930) considered Myzodes to be a subgenus of Phorodon since the second hind

tarsal segment has only 2 setae and the hind tibiae of first instar nymphs are without spines between the setae. In setting up this association he ignored the structure of the antennal tubercles. Later Myzodes was considered to be a separate genus (Börner 1951, 1952a, b, Heinze 1960).

According to Aizenberg (1966), Myzodes has been placed in Myzus because authors considered the character of the antennal tubercles and not the differences in this character in each group. Aizenberg considered Myzodes to be near the Pentalonini, and particularly the genus Fullawayella Del G. (Idiopterus Davis), due to similarities in setae, the structure of the antennal tubercles, and an approximate similarity in the form of the radial sector. However, I would point out that the apterae of Idiopterus have elongate capitate setae on the head and typically bear sensoria on the base of antennal segment III. These characters would seem to place the genus closer to Capitophorus. However, persicae does not have these setae on the head, never has secondary sensoria in the apterae, and has Prunus as its primary host, all typical characters of the genus Myzus.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens yellowish green to green. Color of mounted specimens light amber. Base of antennal segment III pale, head and rest of antennae light brown. Basal 1/3 of femur pale, rest light amber; tibia pale, its apex brown; tarsus brown. Abdomen with a light amber central

sclerotic area and lateral sclerites on a pale background. Cornicles, cauda, and anal and genital plates amber.

Morphology. Body length 1.45-2.25. Antennal tubercles moderately prominent, converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae subequal to body length or somewhat longer, with 8-19 sensoria in a more or less straight row on segment III. Lengths of antennal segments: III, 0.40-0.61; IV, 0.29-0.50; V, 0.10-0.19 + 0.35-0.78. Head width through eyes 0.37-0.45. Rostrum reaches hind coxae; apical segment 0.094-0.135 long, with 2-3, rarely 4, lateral setae and 0-3 surface setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:2. Second hind tarsal segment 0.092-0.140 long. Abdomen with lateral sclerites on segments (I) II-IV, presiphuncular sclerite on V, post-siphuncular sclerite on VI-VII, and a doral sclerotic patch on II-V connected to pleural patches on these segments. Lateral tubercles frequently on any or all of the sclerites II-IV, rarely on V and never on I. Dorsal tubercles frequently on VIII, sometimes on VII. Segment VII with 2-3 dorsal setae, VIII with 4-5. Cornicles 0.29-0.48 long, cylindrical (fundatrigeniae) to slightly swollen (virgingeniae), smooth. Cauda 0.17-0.23 long, conical, not constricted, with 3 pairs of lateral setae, sometimes with only 2 setae on 1 side and 3 on the other or with an additional terminal seta. Anal plate with 12-20 setae evenly distributed. Genital plate with 2 setae anteriorly and

8-12 along the posterior edge, rarely with an additional seta either on the anterior edge or in the center of the plate.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens light yellow to light green. Mounted specimens pale; apex of V, VI, tarsi, and sometimes apex of cornicles brown.

Morphology. Body length 1.56-2.35. Antennal tubercles moderately prominent, parallel, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae subequal to body length, secondary sensorial absent. Lengths of antennal segments: III, 0.32-0.48; IV, 0.24-0.40; V, 0.19-0.30; VI, 0.09-0.19 + 0.32-0.78. Head width through eyes 0.40-0.48. Rostrum reaches hind coxae; apical segment 0.108-0.155 long, with 2-3, rarely 4, lateral setae and 0-3 surface setae in addition to the usual 3 apical pairs. Abdomen without sclerites. Lateral tubercles sometimes on segments III and IV, rarely on V. Dorsal tubercles often on segment VIII and rarely on VII. Segment VII with 2-3 dorsal setae, VIII with 4-5. Cornicles 0.30-0.63 long, cylindrical (fundatrigeniae) to slightly swollen (virginogeniae), lightly imbricated. Cauda 0.17-0.26 long, conical, not constricted, with 3 pairs of lateral setae, rarely with only 2 setae on 1 side and 3 on the other. Anal plate with 9-20 setae evenly distributed. Genital plate with 2 setae anteriorly and 9-17 along posterior edge, rarely with an additional seta either on the anterior edge or in the center of the plate.

FUNDATRIX. Essentially the same as the apterous viviparous female, except for 5-segmented antennae.

MALE. Alate, generally similar to alate viviparous female. Antennal segment III with 28-48 scattered sensoria, IV with 11-30; V with 9-23 in addition to the primary sensorium.

Cauda 0.09-0.13 long, with 6 setae.

OVIPAROUS FEMALE. Red, but otherwise essentially the same as apterous viviparous female. Hind tibiae swollen, with 16-71 pseudosensoria scattered over the middle 2/3 - 3/4 of the segment.

Types. Location of types unknown. Types of Myzus pergandii Sanderson in the USNM.

Distribution. Worldwide. Eastern U.S.: Widespread.

Collections studied. I studied specimens collected from every state within the area. Since this species is so widespread and so polyphagous, I have reduced the collection records for this species to a list of plants, by families, on which this species was collected. ACANTHACEAE: Beloperone sp., Jacobina coccinea Hiern.; ALLIONACEAE: Boerhaavia riscosa Lag. & Rodr. Small Fl., four-o'clock - Mirabilis jilapa L.; AMARANTHACEAE: alligator weed - Alternanthera philoxeroides (Mart.) Griseb., Amaranthus blitoides S. Wats., A. hybridus L., A. retroflexus L., Amaranthus sp., Celosia nitida Vahl.; AMARYLLIDACEAE: Agave sp., Alstromeria sp., Narcissus sp., Polianthes tuberosa L., Sprekelia sp.; AMMIACEAE: dill - Anethum graveolens L., parsley - Apium petroselenium L., Aralia

seiboldii Hort.; APOCYNACEAE: oleander - Nerium oleander L., Vinca major L., V. minor L., Vinca sp.; AQUIFOLIACEAE: Ilex paraguariensis St. Hil., Ilex sp.; ARACEAE: Caladium sp., Philodendron selloum C. Koch; Philodendron sp., Syngonium sp.; ARALIACEAE: Polyscias guilfoylei Bailey, Polyscias sp., Schefflera sp.; ARISTOLOCHIACEAE: Dutchman's pipe - Aristolochia macrophylla Lam., Aristolochia sp.; ASCLEPIADACEAE: Asclepias incarnata L., Asclepias sp., Matelea floridana Woodson; BALSAMINACEAE: Impatiens sp.; BIGNONIACEAE: Catalpa sp.; BORAGINACEAE: Amsinckia barbata Greene, A. douglasiana A. DC, A. intermedia F. & M., Amsinckia sp., Begonia sp., forget-me-not - Myosotis sp., Pavonia hastata Cav., Tournefortia sp.; BROMELIACEAE: Spanish moss - Tillandsia usneoides L.; BUETTNERIACEAE: Riedlea sp.; CACTACEAE: Epiphyllum sp.; CAMPANULACEAE: Campanula sp.; CANNABINACEAE: hop- Humulus lupulus L.; CAPPARIDACEAE: Cleome serrulata Pursh., C. spinosa Jacq.; CAPRIFOLIACEAE: honeysuckle - Lonicera japonica Thunb., Lonicera sp., elderberry - Sambucus sp., Viburnum sp.; CARYOPHYLLACEAE: Cerastium tomentosum L., mouse-ear - C. vulgatum L., carnation - Dianthus barbatus L.; D. caryophyllus L., D. chinensis L., Dianthus sp., Oxalis stricta L., Oxalis sp., Polycarpon tetraphyllum L. f., Silene sp., chickweed - Stellaria media (L.) Vill.; CELASTRACEAE: Euonymous japonica L., Eunymous sp., Shaeffleria sp.; CHENOPODIACEAE: Atriplex sp., Russian pigweed - Axyris amaranthoides L., Baccharis sp., beet - Beta vulgaris L., pigweed - Chenopodium album L.,

C. ambrosioides L., Jerusalem oak - C. botrys L., Chenopodium sp., spinach - Spinacia oleracea L.; COMPOSITAE: Achillea millefolium L., Actinea odorata O. Ktze., ragweed - Ambrosia trifida L., Ambrosia sp., Antennaria sp., Anthemis sp., Aster sp., daisy - Bellis integrifolia Michx., Bellis sp., Bidens sp., Calendula sp., safflower - Carthamus sp., cornflower - Centaurea cyanus L., Chrysanthemum morifolium Ram., Chrysothamnus sp., Cineraria sp., Cirsium lanceolatum (L.) Hill, Dahlia sp., Echinops sphaerocephalus L., Emilia coccinea (Sims) Sweet., Erechtites hieracifolia (L.) Raf., Erechtites sp., Erigeron philadelphicus L., E. strigosus Muhl., Eupatorium serotinum Michx., Gaillardia sp., Gazania sp., Gerbera sp., Gnaphalium obtusifolium L., G. spathulatum Lam., Gynura aurantiaca (Blume) DC, Gynura sp., artichoke - Helianthus tuberosus L., Helianthus sp., straw-flower - Helichrysum sp., Hidalgoa wercklei Hook. f., hawkweed - Hieracium sp., lettuce - Lactuca sativa L., L. scariola L., Lactuca sp., Maruta cotula (L.) DC, Myriocephalus sp., Pyrrhopappus carolinianus (Walt.) DC, Scruentum sp., Senecio aureus L., S. confusus J. Britton, S. decorus Greenm., S. glabellus Poir., Senecioides cinerea (L.) Kuntze, Sonchus arvensis L., S. asper (L.) All., S. oleraceus L., Sonchus sp., marigold - Tagetes sp., Tansy sp., Taraxacum sp., Verbesina sp., cockleburr - Xanthium sp., Zinnia sp.; CONVALLARIACEAE: Asparagus sprengeri Regel.; CONVOLVULACEAE: dodder -

Convolvulus sp., sweetpotato - Ipomoea batatas (L.) Lam., morning glory - Ipomoea sp., bindweed - Strophocaulos sp.; CRASSULACEAE: Bryophyllum pinnatum (Lam.) S. Kurz., Bryophyllum sp., Kalanchoe flammea Stapf., Sedum sp.; CRUCIFERAE: Barbarea vulgaris R. Br., mustard - Brassica alba Boiss., rutabaga - B. campestris L., Chinese cabbage - B. chinensis L., B. juncea (L.) Coss., rape - B. napus L., B. nigra (L.) Koch, cabbage - B. oleracea L., collards (Kale) - B. oleracea acephala DC, broccoli (cauliflower) - B. oleracea botrytis DC, Kohlrabi - B. sinapistrum Boiss., Brassica sp., Cakile edentula (Bigel.) Hook., Capnoides halei Small, shepherd's-purse - Capsella bursapastoris (L.) Medic., Cardaria pubescens (C.A. Meyer) Jarmolenko, Cardaria sp., Dentaria integrifolia Nutt., flixweed - Diplotaxis tenuifolia (L.) DC, Lepidium draba L., L. perfoliatum L., Lepidium sp., Matthiola sp., watercress - Nasturtium officinale R. BR., Norta altissima (L.) Britton, Radicula sp., radish - Raphanus sativus L., R. repanistrum L., horseradish - Roripa armoracia (L.) A. Hitchc., Sisymbrium altissimum L., S. officinale (L.) Britton, Sophia pinnata (Walt.) Britton, Thelypodium laciniatum L.; CUCURBITACEAE: cantaloupe - Cucumis melo L., gourd - Cucurbita lagenaria L., squash - C. maxima Duchesne, crook-neck squash - C. moschata Duchesne, cucumber - C. sativus L., Erodium sp., Luffa sp.; CYPERACEAE: Cyperus esculentus L.;

ERICACEAE: Azalea sp.; Rhodendron sp., blueberry - Vaccinium myrsinites Lam.; EUPHORBIACEAE: Acalypha sp.; FOUQUERIACEAE: Fouqueria splendens Engelm.; GENTIANACEAE: Buddleia sp.; GERANIACEAE: Erodium sp., Geranium carolinianum L., G. dissectum L., Geranium sp.; GRAMINAE: oats - Avena sativa L., foxtail - Chaetochloa sp., Johnson grass - Holcus halpensis L., barley - Hordeum sp., wheat - Triticum vulgare L., corn - Zea mays L.; HEDERACEAE: Hedera helix L.; IRIDACEAE: Freesia sp., Gladiolus sp., Iris tingitana Boiss. & Reut., Iris sp.; LABIATAE: Coleus sp., Galeopsis tetrahit L., gill-over-the-ground - Glechoma hederacea L., Lamium amplexicaule L., Mentha sp., catnip - Nepeta cataria L.; LEGUMINOSAE: Acacia sp., Caesalpinia sp., Cassia sp., Cercis canadensis L., Lupinus sp., alfalfa - Medicago sativa L., sweet clover - Melilotus sp., Phaseolus coccineus L., P. vulgaris L., Phaseolus sp., pea - Pisum sativum L., black locust - Robinia pseudoacacia L., red clover - Trifolium prataense L., white clover - T. repens L., Trifolium sp., cowpea Vigna sinensis L., Wisteria sp.; JUGLANDACEAE: pecan - Carya illinoisensis (Wang) K. Kock; LABIATAE: Salvia azurea Lam., S. greggii A. Gray, S. mellifera Hort., S. microphylla Hort., S. nutans L., Teucrium chamaedrys L., T. flavum Hort., T. scorodonia L.; LILIACEAE: Agapanthus sp., Agave virginica L., leek - Allium porrum L., onion Allium sp., Aloe variegata L., Aloe sp., Asparagus of-

ficinalis L., Chlorophytum sp., Lilium auratum Lindl., L. candidum L., Easter lily - L. longiflorum Thunb., L. longiflorum formosanum Hort., L. speciosum Thunb., L. speciosum rubrum Hort., tulip - L. sylvestris L., tiger lily - L. tigrinum Thunb., Smilax rotundifolia L., Ornithogalum sp., Yucca sp.; LYTHRACEAE: crape-myrtle - Lagerstroemia indica L.; MALVACEAE: okra - Abelmoschus esculentus (L.) Moench., Abutilon sp., hollyhock - Althaea rosea Cav., Crotalaria spectabilis Roth., Gossypium sp., Hibiscus cannabinus L., H. syriacus L., Hibiscus sp., Malva borealis Wallm., M. neglecta Wallr., M. parviflora L., M. rotundifolia L., Malva sp., Malvastrum coromandelianum (L.) Garcke., Malvaviscus drummondii T. & G., Sphaeralcea emoryi Torr., Sphaeralcea sp.; MORINGACEAE: Moringa oleifera Lam.; MUSACEAE: banana - Musa sp.; MYRICACEAE: Myrica sp.; MYRTACEAE: guava - Psidium guajava Raddi; NYCTAGINACEAE: Bougainvillea glabra Choisy., Bougainvillea sp.; NYMPHAEACEAE: Nelumbo sp.; OLEACEAE: lilac - Syringa vulgaris L., OSMANTHUS sp.; ONAGRACEAE: Fuschsia sp., evening primrose - Oenothera laciniata Hill, O. speciosa Nutt., Oenothera sp.; ORCHIDACEAE: Cattaleya sp., Cymbidium sp., Cyripedium sp., Epidendrum secundum Jacq., Ibidium odoratum (Nutt.) House, Saccolabium sp.; PALMAE: Sabal sp.; PAPAVERACEAE: bleeding heart - Dicentra sp., Papaver somniferum L., Papaver sp.; PAPAYACEAE: papaya - Carica papaya L.; PASSIFLORACEAE: Passiflora edulis L.; PEDIA-

LACEAE: Sesamun orientale L., Sesamum sp.; PHYTOLACCACEAE: pokeweed - Phytolacca decandra L., Phytolacca sp.; PIPERACEAE: Piper sp.; PITTOSPORACEAE: Pittosporum undulatum Vent., Pittosporum sp.; PLANTAGINACEAE: Plantago virginica L.; PLUMBAGINACEAE: Limonium sp.; POLYGONACEAE: buckwheat - Fagopyrum fagopyrum (L.) Karst., Nephrolepis sp., smartweed - Persicaria sp., Polygonum convolvulus L., P. lapathifolium L., P. pennsylvanicum L., rhubarb - Rheum sp., curled-dock (yellow-dock) - Rumex cripus L., R. obtusifolius L., red dock R. sanguineus L., Rumex sp.; PORTULACEAE: Portulaca sp.; PROTEACEAE: Protea sp.; PRIMULACEAE: Cyclamen sp., Primula sp.; RANUNCULACEAE: Anemone sp., Clematis recta L. var. mandshurica Maxim., Delphinium sp., Paeonia sp., Ranunculus sp.; ROSACEAE: Chaenomeles sp., Crataegus compitalis Beadle, C. limnophiloides Murrill, C. newelliana Murrill, C. subpaludosa Murrill, C. subviridis Beadle, Crataegus sp., Cydonia sp., strawberry - Fragaria sp., apple - Malus sylvestris Rydb., Malus sp., plum - Prunus americana Marsh., apricot - P. armeniaca L., sour cherry - P. cerasus L., P. emarginata L., P. fasciculata L., P. hortulana Bailey, P. nigra Ait., pin cherry - P. pennsylvanica L. f., P. serotina Ehrh., chockcherry - P. virginiana L., Prunus sp., pear - Pyrus communis L., Rosa sp., Rubus alleghaniesis Porter, red raspberry - R. carolinianus Rybd., blackberry - R. laciniatus Willd., R. occidentalis L., R. phoenicolasius

Penstemon sp., mullen - Verbascum sp., Veronica sp.; SOLANACEAE: red pepper - Capsicum anuum L., C. baccatum L., C. betacea L., C. frutescens L., Capsicum sp., Cestrum nocturnum L., Datura meteloides Dunal., Jimpson weed - D. stramonium L., Datura sp., Hyoscyamus niger L., Lycium halimifolium Mill., tomato - Lycopersicon lycopersicon (L.) Karst., Nicotiana glauca Graham, tobacco - N. tabacum L., Petunia sp., Physalis turbinata Medic., Physalis sp., horse-nettle - Solanum carolinense L., white horse-nettle - S. elaeagnifolium Cav., eggplant - S. melongena L., S. nigrum L., Jerusalem-cherry - S. pseudocapsicum L., S. seaforthianum Andr., S. tuberosum L., Solanum sp.; SPONDIACEAE: mango - Mangifera indica L.; TAMARICACEAE: Tamarix sp.; THEACEAE: Camellia sp.; TROPAEOLACEAE: nasturtium - Tropaeolom majus L.; UMBELLIFERAE: celery - Apium graveolens L., Chaerophyllum teinturieri Hook., coriander - Coriandrum sativum L., carrot - Daucus carota L., Eryngium sp., parsley - Torilis nodosa (L.) Gaertn.; URTICACEAE: Urtica sp.; VERBENACEAE: Caryopteris sp., Cierodendron bungeii Hort., C. hyracoides Hort., C. nutans Hort., C. trichotomum Hort., Cochranea anachusaefolia (Poir.) Guerke., Lippia sp., Tectona grandis L., Verbena sp.; VIOLACEAE: Viola arvensis Murr., V. odorata L., pansy - V. tricolor L., Viola sp.; VITACEAE: Virginia creeper - Parthenocissus quinquefolia (L.) Planch. USNM, FSCA, CFS, HBB, HGW, JOP.

See also Horsfall (1924), Gillette and Palmer (1934), Cottier (1953), Bodenheimer and Swirski (1957) and Leonard, et al. (1970).

Biology. Mordwilko (1907) first combined the individual work of earlier authors into a pattern of host alternation for M. persicae between peach and many herbaceous plants. Gillette and Taylor (1908) independently made a similar report.

Eggs overwinter on Prunus persica Sieb. & Zucc., P. persica nucipersica Schneid., and older trees of P. serotina Ehrh. (Börner 1951, Meier 1954). The eggs hatch in early spring producing nymphs which mature into fundatrices. There are up to 8 fundatrigenious generations on the primary hosts. Alates produced in April-June migrate to many different herbaceous secondary hosts; in general they alight, leave a few progeny, and then fly to another plant and repeat the process (van Emden, et al. 1969). During September and October gynoparae fly to various Prunus spp. Males are produced in October-early November and fly to the primary hosts and mating occurs. Eggs are then laid from late October to early December (Horsfall 1924). Berry and Simpson (1967) found that heavy flights in mid-June and again in early or mid-September corresponded with peak periods of potato growth.

Hille Ris Lambers (1946) pointed out that the gynoparae are not host selective but males prefer peach although they do frequently fly to other hosts; and the nymphs hatching from eggs mature only on peach and nectarine. This lack of selectivity in host selection has resulted in several erroneous reports concerning the primary host plants for this aphid. Gillette and Taylor (1908) reported overwintering

on peach (Prunus persica), plum (P. domestica L. and americana Marsh.), apricot (P. armeniaca L.), nectarine (P. persica nucipersica), cherry (P. cerasus L.), prune (P. insitita L.), and oviposition on chokecherry (P. virginiana L.), and sandcherry (P. melanocarpa Shafer). Gillette and Palmer (1934) listed Prunus persica, domestica, americana, melanocarpa, cerasus, armeniaca, and besseyi Bailey (sandcherry) as winter hosts. These reports were interpreted by Börner (1951) as a confusion between primary and secondary colonization.

A report of hibernation on P. nana Stokes by Wahlgren (1939) was verified by Hille Ris Lambers (1952a), but Börner (1952b) and Meier (1954) were unable to find eggs on this host. Gorham (1942, in Hille Ris Lambers 1946) listed P. nigra Ait. as an overwintering host in Canada; a similar report was made by Shands and Simpson (1948) in Maine. These reports differentiate between primary colonization and autumn wandering flights of virginogeniae. Because Heinze (1948a, b) never found persicae on P. nigra in the Dahlem Botanical Garden, Börner (1951) concluded that this is a subspecies of nigra endemic to North America and not found in Europe.

Reports of overwintering on cabbage (Huckett 1925, Theobald 1926) and roses (Fenjves 1945, Volkhart 1939, in Hille Ris Lambers 1946) are believed to be the result of misidentifications (Börner 1951).

The green peach aphid also overwinters parthenogenetically on herbaceous plants in greenhouses and in the field if the climate is mild, particularly in tropical and subtropical

areas (van der Goot 1917, Mason 1922, Heinze and Profft 1938, Jacob 1941, Moericke 1941, 1949, Heie 1954). Gillette and Bragg (1915) and Mordwilko (1935a, b) assumed that these represented an independent anholocyclic race, having lost its generations on peach. Heinze and Profft (1938) and Klinkowski and Leius (1943) could not however demonstrate anholocyclism.

Distinguishing characteristics. Color yellow to green. Second hind tarsal segment with 2 setae. Cornicles swollen (virginogeniae).

M. persicae is very close morphologically to Myzus certus (Walker), a pink or brown aphid found on carnation and other Caryophyllaceae. The color of the living aphids is sufficient to distinguish between the two. However, since most specimens studied are either mounted on slides or in alcohol and the living color is not evident, the taxonomist must resort to morphological differences which are not always exactly differentiating. Hille Ris Lambers (1959, 1966) pointed out that certus usually has 2 pairs of lateral setae on the apical rostral segment while persicae only rarely has 2 complete pairs. The ventral sclerites on the abdomen of certus are usually very distinct and in a straight row, whereas, in persicae they appear to be absent; also, certus alatae may have sensoria on antennal segment IV. The apterae of certus always have swollen cornicles which are wholly dark, and the dorsum of the abdomen is slightly sclerotic and pigmented; the fundatrices frequently have 6-segmented antennae; and, the males are apterous (Hille Ris Lambers 1946, 1966). Additionally the terminal

filament of summer apterae is subequal to twice the length of the base in certus and always greater than 3 times the length of the base in persicae (Hille Ris Lambers 1966).

I have also found the following characters to be useful for separating the two species. In certus the sensoria on antennal segment III are frequently doubled at 1 or more locations, whereas in persicae this is only rarely the case. Abdominal segment VII in alate certus frequently has 3 setae on the postsiphuncular sclerite; the usual number in persicae is 2. And, the dorsal tubercles on abdominal segment VIII in certus are subequal to the diameter of the setal membranes of the dorsal setae on that segment, while in persicae they are freqnetly as much as 3 times that diameter.

As Hille Ris Lambers (1966) stated, no one character will always separate the 2 species, but an analysis of a combination of characters is necessary in order to arrive at an identification; and, all specimens will not be able to be identified positively.

The other species of Myzus which are very similar morphologically to persicae (ajugae Schouteden, 1903, ascalonicus Doncaster, 1946, myosotidis Borner, 1950, polaris Hille Ris Lambers, 1952b, linariae Holman, 1965, and dianthicola Hille Ris Lambers, 1966) are not found in the Eastern United States.

Myzus certus (Walker)

Aphis certa Walker 1849: appendix 32.
Rhopalosiphum dianthi (Schrank) in part. Williams 1910:69.

Myzus persicae var. cerastii Theobald 1926: 323.
Myzus caryophyllacearum Hille Ris Lambers 1946: 198.
Myzus certus (Walker). Hille Ris Lambers 1946: 198-9. -- Meier 1954: 361.
Myzodes auctus Börner nec Walker 1951: 103.
Myzodes certus (Walker). Börner 1951: 103. - Heinze 1960: 842.
Myzodes auctus pseudopersicae Borner 1952b: 469.

Börner (1951, 1952b) considered auctus (Walker 1849) and certus to be separate species and placed persicae cerastii Theobald and caryophyllacearum Hille Ris Lambers as synonyms of auctus. However, Walker described the apterae of auctus as green, and Doncaster (1961) concluded from transfer experiments that caryophyllacearum and certus are the same species. This is the view taken in this paper.

Because this aphid is so similar to Myzus persicae (Sulzer) I have not figured it separately and will not take up the space with a complete description. I will however list the chief distinguishing characteristics.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens dark brown to black.

Morphology. Antennal segment III with 8-17 sensoria in a more or less straight line, usually more than 10 in number and with 2-3 clustered at 1 or more locations; segment IV with 0-2. Apical rostral segment with 2 pairs of lateral setae and 0-3 surface setae in addition to the usual 3 apical pairs, rarely with only 3 lateral setae in addition to the surface and apical setae. Cornicles always swollen, lightly imbricated. Postsiphuncular sclerite on abdominal segment VI usually with 3 setae, occasionally with 2. Lateral tubercles usually on any or all sclerites on segments II-IV, never on I and V. Dorsal

tubercles usually on abdominal segment VIII, sometimes on VII; in size, subequal to the diameter of the membrane surrounding the base of the dorsal setae on that segment, rarely twice as much as that diameter or more. Ventral sclerites distinct, arranged in 2 parallel rows ventrolaterally.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens pink or brown. Cornicles wholly dark, or dark other than at extreme apex only.

Morphology. Terminal filament of summer apterae subequal to twice the length of the base of antennal segment VI; in other morphs as in persicae. Setae on apical rostral segment as in alate viviparous female. Dorsum of abdomen sclerotic, pigmented. Cornicles always swollen, lightly imbricated, usually with the basal portion significantly wider than the mid-portion of the hind tibia. Dorsal tubercles, when present, as in alate vivparous female.

MALE. Apterous; 34-46 sensoria on antennal segment III, 16-20 on IV, and 8-13 on V in addition to the primary sensorium at the distal end.

OVIPAROUS FEMALE. Hind tibia slightly swollen, with 20-32 pseudosensoria located in the middle 1/2-2/3 of the segment.

Type: In the British Museum.

Distribution. Holarctic and Oriental on Caryophyllaceae and Violaceae. Eastern U. S.: Widespread.

Collections studied. MAINE: Presque Isle, 11 Oct. 1961 (Shands), Stellaria media (L.) Vill. MASSACHUSETTS:

England at Boston, 5 June 1932 (C. A. Davis), carnation; Germany at Boston, 13 Apr. 1956 (J. D. Crump, Jr.), carnation; Ireland at Boston, 17 June 1964 (VanValkenburgh), Dianthus caryophyllus L.; England at Boston, 17 June 1965 (J. M. VanValkenburgh), Dianthus sp.; Waltham, 12 Mar. 1954 (F. Smith), carnation. NEW YORK: Bellmore, 21 Mar. 1958 (G. V. Johnson), chickweed; Farmingdale, 6 Apr. 1946 (F. F. Smith), carnation; 3 Jan. 1961 (G. V. Johnson), carnation; England at New York, 7 Mar. 1949 (Laddey), carnation; Germany at New York, 4 July 1958 (C. Post), Dianthus sp.; Mexico at New York, 3 Dec. 1958 (G. Vanech), carnation; France at New York, 14 Jan. 1959 (E. Erickson), Dianthus sp.; Mexico at New York, 30 Jan. 1959 (T. Reid), Dianthus sp.; 5 Feb. 1959 (Snowden and Reid), Dianthus sp.; 7 Feb. 1959 (T. Reid), Dianthus sp.; Holland at New York, 15 Oct. 1959 (A. L. Brown), on Gypsophilla sp.; Mexico at New York, 12 May 1960 (L. Walden), carnation; England at New York, 3 June 1960 (L. Walden), rose; Israel from New York, 11 June 1960 (L. Walden), carnation; Germany at New York,11 June 1960 (L. Walden), carnation; Switzerland at New York, 12 July 1962 (Shiroishi), Dianthus sp. MICHIGAN: Scotland at Detroit, 10 July 1968 (Husnik), Dianthus caryophyllus L. PENNSYLVANIA: Philadelphia, 20 Aug. 1969 (Arehart), Dianthus caryophyllus L.; Lancaster, 1 Apr. 1946 (F. F. Smith), Viola sp. ILLINOIS: Germany at Chicago, 6 Apr. 1957 (G. E. Brenneke), carnation; Mexico at Chicago, 11 Mar. 1958 (R. E. Boyd), carnation; 29 Mar. 1959 (G. E. Brenneke), Dianthus sp.; 4 Mar. 1960 (J. Rood), carnation;

23 May 1960 (R. Aolman), Dianthus sp.; 14 Mar. 1961 (J. Rood), Dianthus caryophyllus L.; 11 May 1961 (Rood and Brenneke), carnation; 16 May 1961 (Crane), Dianthus sp.; Italy at Chicago, 19 Apr. 1962 (J. Rood), Dianthus caryophyllus L.; Mexico at Chicago, 5 Jan. 1963 (J. Rood), Dianthus caryophyllus L.; 11 Feb. 1963 (Kennedy), Dianthus sp.; 17 Mar. 1963 (Imai), carnation; 26 Mar. 1963 (J. Rood), Dianthus caryophyllus L. NEW JERSEY: England at Hoboken, 30 Apr. 1947 (Olsen), Dianthus sp.; 11 May 1958 (Bennett), Dianthus sp.; Denmark at Hoboken, 17 Oct. 1956 (R. D. Munkittrick), Dianthus sp.; Weston, 5 Apr. 1946 (F. F. Smith), carnation. WASHINGTON, D.C.: 7 May 1898 (T. Pergande), pink. NORTH CAROLINA: Atlantic Beach, 7 Apr. 1968 (C. F. Smith), pansy; Raleigh, 14 Apr. 1961 (J. Graham), pansy; 29 Dec. 1961, same data. GEORGIA: Moultrie, 17 Feb. 1949 (W. G. Genung), violet. FLORIDA: Gainesville, 21 Feb. 1950 (A. N. Tissot), pansy; 10 Feb. 1956 (R. W. Blacklock), pansy; Mexico at Tampa, 29 Nov. 1961 (F. W. Patton), carnation; Mexico at Miami, 2 Dec. 1959 (Faircloth and Higgins), carnation; 5 Feb. 1960 (Faircloth and Higgins), carnation; 23 Oct. 1961 (Rowan and Nakahard), carnation; 17 Mar. 1962 (R. P. Higgins), carnation; 19 Oct. 1964 (L. A. McClain), Dianthus sp.; 7 Dec. 1964 (H. S. Harrison), carnation. ALASKA: Japan at Anchorage, 27 Jan. 1967 (D. V. Akins), Dianthus sp. WASHINGTON: England ? at Seattle, 24 Apr. 1961 (Bryan and Nelson), carnation. MISSOURI: Columbia, 29 Mar. 1905 (Hayhurst), pansy. NEW MEXICO, Bayard, 20 Oct. 1961 (Nielsen and Heninger), carnation. CALIFORNIA: Palo Alto, 15 Nov.

1956 (Doucette), carnation; Arcadia, 13 May 1969 (H. G. Walker), Cerastium tomentosum L.; 23 Oct.1969, same data; 13 Feb. 1970 (H. G. Walker), Cerastium tomentosum L. and Viola tricolor L. hortensis Hort.; 13 May 1970 (H. G. Walker) Hymenanthera sp.; 5 Nov. 1970 (H. G. Walker), Cerastium tomentosum L. HAWAII: Japan at Hawaii, 15 Mar. 1962 (H. A. Woolford), Dianthus caryophyllus L.; 11 Mar. 1963, same data; 18 May 1965 (W. Chun), Dianthus caryophyllus L. USNM, FSCA, CFS, HGW.

Although most of these records are for introduced aphids, I do not believe that this accurately represents the occurrence of this species in the Eastern U.S.

Biology. This species may hibernate as eggs on Cerastium spp., Dianthus deltoides L. or Viola arvensis Murr. Fundatrices hatch in early April. Alates are produced by the third generation in late May - early June which may migrate to Stellaria media (L.) Vill. or to other species of Dianthus and Viola. Oviparae and males develop in mid-October. M. certus may also live parthenogenetically thoughout the year on its host plants (Hille Ris Lambers 1946, 1959, Meier 1954).

The means by which certus can be separated from persicae have been discussed under the latter species.

Figure 6.--*Myzus persicae* (Sulzer), A-L. A-F, alate viviparous female: A, head and antennal segments I-III; B, sclerotic pattern on abdomen (1/2 scale); C, rostrum; D, cauda; E, cornicle of fundatrigenious alate; F, same of virginogenious alate; G-J, apterous viviparous female: G, head H, cauda; I, cornicle of fundatrigenious aptera; J, same of virginogenious aptera; K-L, male: K, cauda; L, antennal segments III-V. *M. varians* Davidson, M-T. M-O, S, alate viviparous female: M, head and antennal segments I-III; N, sclerotic pattern on abdomen (1/2 scale); O, cornicle; S, cauda; P-R, T, apterous viviparous female: P, cornicle; Q, head; R, rostrum; T, cauda.

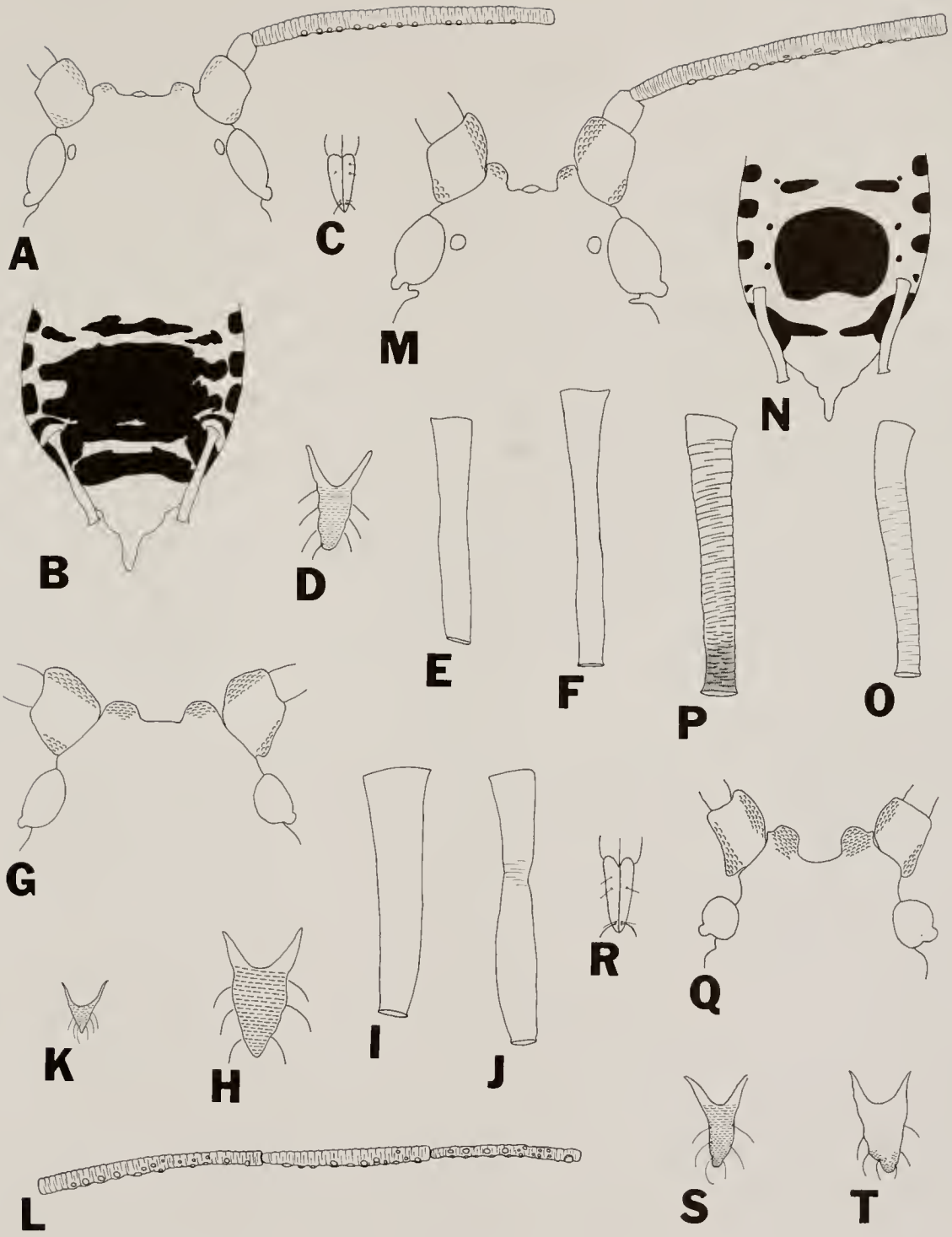

Figure 6

Myzus varians Davidson

Figure 6, M-T

Myzus varians Davidson 1912: 409. -- Meier 1954: 232.
Myzus tropicalis Takahashi 1923: 24.
Myzus clematifoliae Shinji 1924: 369.
Myzodes varians (Davidson). Börner 1952b: 123. - Heinze 1960: 830, 838.
Phorodon varians (Davidson). Börner 1952b: 123. - Heinze 1960: 830.

Börner (1952b) placed this species in Phorodon because the antennae of first instar nymphs are indistinctly 5-segmented, rather than distinctly 5-segmented as in the genus Myzodes (Myzus). Heinze (1960) followed this scheme, but at the same time placed the species in Myzodes because all other aspects, aside from the segmentation of the antennae of first instar nymphs, agree with the characterization of the latter group. Since Myzodes is considered to be a synonym of Myzus Pass., varians is placed in the latter genus in this paper.

ALATE VIVIPAROUS FEMALE. Coloration. Color of living specimens green with a reddish tinge. General color of mounted specimens yellowish amber. Head light amber. Antennal segments I, II, most of III, extreme base and apex of IV and V, and all of VI amber; base of III and rest of IV and V pale. (Paralectotype with segments IV and V wholly amber.) Tibia pale; its apex and tarsus yellowish amber. Dorsal patch and lateral sclerites on abdomen amber on a pale background. Cornicles amber. Cauda and anal and genital plates light yellow.

Morphology. Body length 1.28-1.73. Antennal tubercles moderately prominent, converging, scabrous. Setae on head

and antennae pointed, inconspicuous. Antennae longer than body, with 7-8 (12) sensoria in a straight row on segment III. Lengths of antennal segments: III, 0.43-0.53; IV, 0.34-0.42; V, 0.29-0.37; VI, 0.11-0.14 + 0.63-0.73. Head width through eyes 0.39-0.43. Rostrum does not reach middle coxae; apical segment 0.108-0.117 long, with 1, rarely 2, pair of lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:2. Second hind tarsal segment 0.079-0.097 long. Abdomen with a dorsal sclerotic patch on segments III-V, lateral sclerites on II-IV, small presiphuncular sclerite on V and postsiphuncular sclerite on VI. Segment VII sclerotic laterally but not continuous with the postsiphuncular sclerite. Abdominal tubercles absent. Segment VII with 2 dorsal setae, VIII with 4. Cornicles 0.35-0.42 long, cylindrical, imbricated. Cauda 0.16-0.17 long, conical, apex acute, with 7-9 lateral setae. Anal plate with 12-16 setae evenly distributed. Genital plate with 2 setae anteriorly and 10-16 along posterior edge, rarely with an additional seta in the center of the plate.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens light green. General color of mounted specimens pale yellow. Apex of antennal segments III-V, apical part of the base of VI and apex of cornicles amber. Tarsi light brown. Rest of specimen pale yellow.

Morphology. Body length 1.28-1.73. Antennal tubercles moderately prominent, converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae longer than body; secondary sensoria absent. Lengths of

antennal segments: III, 0.31-0.50; IV, 0.25-0.36; V, 0.25-0.35; VI, 0.11-0.13 + 0.53-0.66. Head width through eyes 0.34-0.41. Rostrum reaches hind coxae; apical segment 0.112-0.115 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.076-0.097 long. Abdominal sclerites and tubercles absent. Segment VII with 2 dorsal setae, VIII with 4. Cornicles 0.35-0.50 long, cylindrical, curved, moderately imbricated. Cauda 0.17-0.20 long, elongated and conical, not constricted, with 2-3 pairs of lateral setae and frequently an additional preapical seta. Setae on anal plate as in alate viviparae. Genital plate with 2 setae anteriorly and 9-11 along posterior edge.

No sexual forms were available for study. The following descriptions are from Meier (1954).

MALE. Generally similar to alate viviparous female. Antennal segment III with 40-55 scattered sensoria; IV with 16-25; and V with 3-21 in addition to the primary sensorium.

OVIPAROUS FEMALE. Essentially the same as apterous viviparous female. Hind tibiae somewhat swollen and bearing many pseudosensoria.

Types. Two slides in the USNM contained 1 apterous and 4 alate viviparous females. One of the latter which corresponds to Davidson's "light form" is Macrosiphum euphorbiae (Thos.). The apterous viviparous female was designated lectotype and the other alate viviparous females, morpholectotype and 2 paralectotypes. These latter 3 specimens (Davidson's "dark form") agree with Shinji's (1924) description of clematifoliae, a synonym of varians, but differ

from the majority of the specimens studied in the coloration of antennal segments IV and V. I therefore designated the following plesiotypes which have antennal segments IV and V dark only at the extreme base and apex of each segment; the rest of these segments is pale: 4 alate viviparous females; Myakka State Park, Fla., 8 Apr. 1969 (D. H. Habeck), Clematis sp., in the USNM and FSCA.

Distribution. Nearctic, Oriental. Eastern U.S.: North Carolina, Florida.

Collections studied. In addition to the lectotypic specimens above, NORTH CAROLINA: Raleigh, 28 May 1964 (C. F. Smith and J. Graham), Clematis sp.; Wake Co., 1 June 1964 (J. Graham), Clematis sp. FLORIDA: Gainesville, 19 Aug. 1970 (R. J. Nielsson), Clematis catesbyana Pursh; Myakka State Park, 8 Apr. 1969 (D. H. Habeck), Clematis sp. CALIFORNIA: Davis, 20 Mar. 1970 (T. Kono), Clematis sp. FSCA, CFS.

Biology. This species overwinters on peach, Prunus persica. The fundatrices hatch from mid-March to early April and by the end of April are fully grown producing offspring. There are 3 fundatrigenious generations on peach and by mid-June the aphids can be found on Clematis spp. Meier (1954) reported that fundatrigeniae reared on peach in the laboratory had no alates in the first generation, 7.5% alate in the second, and 84% in the third; and, the maturation of this third generation coincided with the

appearance of alates on Clematis in the field. Males and gynoparae are produced in late October-early November and migrate to peach where the gynoparae give birth to oviparae. The sexuales mate and eggs are laid in late November-December.

Meier (1954) reported that the species may also live parthenogenetically throughout the year inside rolled peach leaves.

Distinguishing characteristics. Alate viviparae usually with the extreme base and apex of antennal segments IV and V dark and the rest of these segments pale. Apterous viviparae with the apex of segment III, base and apex of IV and V and apex of the base of VI dark; rest of antennae pale. Cornicles straight to slightly curved, with apex dark in apterae. Abdominal tubercles absent (in the forms on Clematis).

GENUS PHORODON PASSERINI

Phorodon Passerini 1860: 27.
Ovatus (Phorodon) van der Goot. Quednau 1966: 426.

Hille Ris Lambers (personal communication, in Leonard 1963) stated that the genus Ovatus is primarily associated with the Pomoideae and migrates to Labiatae as summer hosts, or has developed an independent cycle with sexuales on Labiatae; however, the genus Phorodon is associated with Prunoideae and migrates to Urticaceae, or has developed a complete cycle on the latter. This, then, defines two biologically distinct groups which should not be joined together, as was done by Quednau (1966).

Mordwilko (1914) placed Phorodon, with Ovatus, in the Rhopalosiphea because the antennal tubercles, aside from the projecting processes, are low and only slightly protruding. Börner (1930) and Börner and Schilder (1932) placed Phorodon and Myzodes in the genus Phorodon, based on the lack of spines on the hind tibia of first instar nymphs and the presence of only 2 setae on the first segment of the hind tarsus of early nymphs and in so doing ignored the differences in the nature of the antennal tubercles. Considering the latter character Phorodon and Myzodes were then recognized as separate genera and placed in the tribe Phorodontini (Börner 1952b).

Characteristics: Antennal tubercles with very prominent projections, especially evident in apterae. Alate viviparae with sensoria on antennal segments III and IV, absent in

apterae. Rostral segment III with 2 pairs of lateral setae. Wing venation normal. Alate viviparae with a dorsal pigmented patch on the abdomen, absent in apterae. Cornicles cylindrical; cauda elongate, acutely conical.

Type: Aphis humuli Schrank, 1801

Distribution: Holarctic.

One species occurs in the Eastern United States, Phorodon humuli (Schrank).

Phorodon humuli (Schrank)

Figure 7

Aphis pruni Geoffrey 1762: 497. (nomen nudum)
Aphis pruni Scopoli 1763. (junior homonym)
Aphis humuli Schrank 1801: 110.
Phorodon humuli (Schrank). Buckton 1876: 166-8 - Theobald 1926: 273-8. - Gillette and Palmer 1934: 207. - Sampson 1939: 173.
Myzus humuli (Schrank). Pepper 1965: 210.
Phorodon pruni (Geoffrey). Aizenberg 1966: 137.
Ovatus (Phorodon) humuli (Schrank). Quednau 1966: 426.

Aizenberg (1966) stated that Aphis pruni Geoffrey 1762 = pruni Scopoli 1763 = humuli Schrank 1801 and therefore the name of the hop aphis should be Phorodon pruni (Geoffrey). However, pruni Geoffrey is synonymous with Hyalopterus arundinis (Fab.). A. pruni Scop. which is a junior homonym is then replaced by humuli Schrank (Hottes 1930).

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens light greenish yellow. General color of mounted specimens light brown. Head brown, antennae light brown, base of segment III pale. Thorax brown. Wings hyaline, veins amber. Apex of femur and tibia and tarsi light brown, base of femur and tibia pale to light yellowish brown. Abdomen pale. Pigmented spots on abdomen, cornicles, cauda, and anal and genital plates brown.

Morphology. Body length 1.50-1.97. Antennal tubercles

very prominent, slightly converging, tapering, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae slightly shorter than body, with 23-31 scattered sensoria on segment III, and 1-5 in a straight line on IV. Lengths of antennal segments; III, 0.44 -0.56; IV, 0.25-0.35; V, 0.26-0.29; VI, 0.10-0.12 + 0.42-0.47. Head width through eyes 0.38-0.40. Rostrum reaches middle coxae; apical segment 0.094-0.108 long, distinctly longer than the second hind tarsal segment, with 2-3 lateral setae and sometimes an additional seta on the dorsal surface in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.081-0.090 long. Lateral sclerites on abdominal segments I-VI; pigmented areas pleurally on I-IV, connected medially on III-IV forming a loose dorsal patch, together with pigmented transverse areas on VI-VII. Abdominal segments VII and VIII each with 4 dorsal setae. Abdominal tubercles absent. Cornicles 0.30-0.41 long, cylindrical, weakly imbricated. Cauda 0.15-0.16 long, acutely conical, not constricted, with 6-7 lateral setae. Anal plate with 14 setae evenly distributed. Genital plate with 2 setae anteriorly, 2-3 on the midline of the plate and 9-10 along the posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens pale green. General color of mounted specimens pale-light amber. Head light amber; antennal segment II and base of III pale, rest of antennae light amber-brown. Legs brown. Abdomen pale, pigmented areas absent. Cornicles, cauda, and anal and genital plates light amber.

Morphology. Fundatrix. Body length 2.08-2.22. Antennal tubercles not prominent, without frontal projections. Setae on head and antennae blunt to pointed, inconspicuous. Antennae shorter than body, secondary sensoria absent. Antennae 5-segmented; lengths of antennal segments: III, 0.35-0.36; IV, 0.17-0.19; V, 0.09-0.10 + 0.08-0.10. Head width through eyes 0.42-0.48. Rostrum reaches middle coxae; apical segment 0.109-0.119 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.083-0.099 long. Abdominal sclerites and tubercles absent. Abdominal segment VII with 2 dorsal setae, VIII with 4. Cornicles 0.46-0.47 long, cylindrical, tapering and curved, strongly imbricated. Cauda 0.22-0.23 long, conical, with 7-10 lateral setae. Anal plate with 14 setae evenly distributed. Genital plate with 2 setae anteriorly, 3-7 along midline of plate, and 10-14 along posterior edge.

Spring Viviparae. Similar to fundatrix. Antennal tubercles well developed, converging, with well-developed frontal projections. Antennae 6-segmented; lengths of antennal segments: III, 0.47-0.52; IV, 0.30-0.33; V, 0.28-0.32; VI, 0.11-0.13 + 0.36-0.40. Cornicles 0.66-0.70 long. Other features as in fundatrix.

Fall Viviparae. Much smaller than summer apterous viviparae. Body length 1.00-1.37. Lengths of antennal segments: III, 0.18-0.26; IV, 0.13-0.18; V, 0.13-0.18; VI, 0.06-0.08 + 0.21-0.28. Head width through eyes

0.26-0.29. Apical rostral segment 0.083-0.088 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Cornicles 0.24-0.40 long. Cauda 0.12-0.15 long, with 6-7 lateral setae. Other features as in fall viviparae.

MALE. Generally similar to alate viviparous female. Body length 1.50-1.63. Antennae slightly longer than body, with 41-55 sensoria on segment III, 15-25 on IV, and 6-10 on V in addition to the primary sensorium. Cornicles 0.28-0.31 long, distinctly tapered and slightly enlarged apically. Cauda 0.08-0.10 long. Anal plate with 9-12 setae evenly distributed.

OVIPARA. Essentially the same as fall apterous viviparae, except antennal segments III and IV sometimes fused or incompletely separated. Hind tibiae slightly swollen, with 42-63 pseudosensoria along almost the entire length.

Types. Location of types unknown.

Distribution. Holarctic. Eastern U.S.: Maine, New York, Washington, D.C., Virginia.

Collections studied. MAINE: Ashland, 29 Sept. 1953 (W. A. Shands), Prunus nigra Ait.; Houlton, 29 Sept. 1953 (W. A. Shands), Prunus nigra Ait. NEW YORK: Richfield Springs, 28 Sept. 1887 (T. Pergande), plum; 6 June 1888, same data. WASHINGTON, D.C.: 16 Nov. 1903 (T. Pergande), prune. VIRGINIA: Vienna, 10 May 1915 (A. C. Baker), plum. MANITOBA: Winnipeg, 22 Aug. 1965 (K. A. Hamilton), Humulus lupulus L. WASHINGTON: Ellensburg, 13 Oct. 1940

(Christenson), chokecherry; Wenatchee, 25 June 1915 (Newcomer), prune. OREGON: Albany, 20 Sept. 1933 (N.P.L.), prune; 7 Oct. 1933 (J. Reaf), prune; Corvallis, 19 Sept. 1933 (J. Reaf), hops; Riddle 15 May 1938 (S. C. Jones) prune. CALIFORNIA: San Francisco, 25 May 1916 (E. O. Essig), plum. USNM, FSCA, CFS.

Biology. Generally, the hop aphids overwinter as eggs on plum and prune. The eggs hatch in April-early May producing the apterous viviparous stem-mothers, or fundatrices. Alate viviparae appear in late May-July and migrate to hops, Humulus lupulus L. or they may remain on plum throughout the year (Gillette and Taylor 1908). The viviparae go through 3-4 generations on hops during the summer and in August-September gynoparae and males return to the primary host. Eggs are laid in October-November. Clarke (1904) reported that the aphids may overwinter as eggs on or in hop vines, or in the ground near the vines because oviparae were found on hops in September and the first generations in the spring were apterous viviparous females in early May. Parker (1913) noted that the hop aphid may overwinter as viviparae on the roots of the hop plants; and, that fall migrant viviparae sometimes flew to cherry, alder, peach, and apple, but no eggs were laid indicating that in mild winters they might survive parthenogenetically on these hosts.

Distinguishing characteristics. Elongate finger-like projections on the antennal tubercles of apterous viviparae; antennal tubercles of alate viviparae very prominent, although without projections as obvious as in apterae.

Figure 7.--Phorodon humuli (Schrk.). A-E, alate viviparous female: A, head and antennal segments I-IV; B, sclerotic pattern on abdomen (1/2 scale); C, rostrum; D, cornicle; E, cauda; F-H, apterous viviparous female: F, head; G, cornicle; H, cauda; I-K, male: I, head and antennal segments I-V; J, cornicle; K, cauda; L-O, oviparous female: L, head; M, cornicle; N, cauda; O, hind tibia.

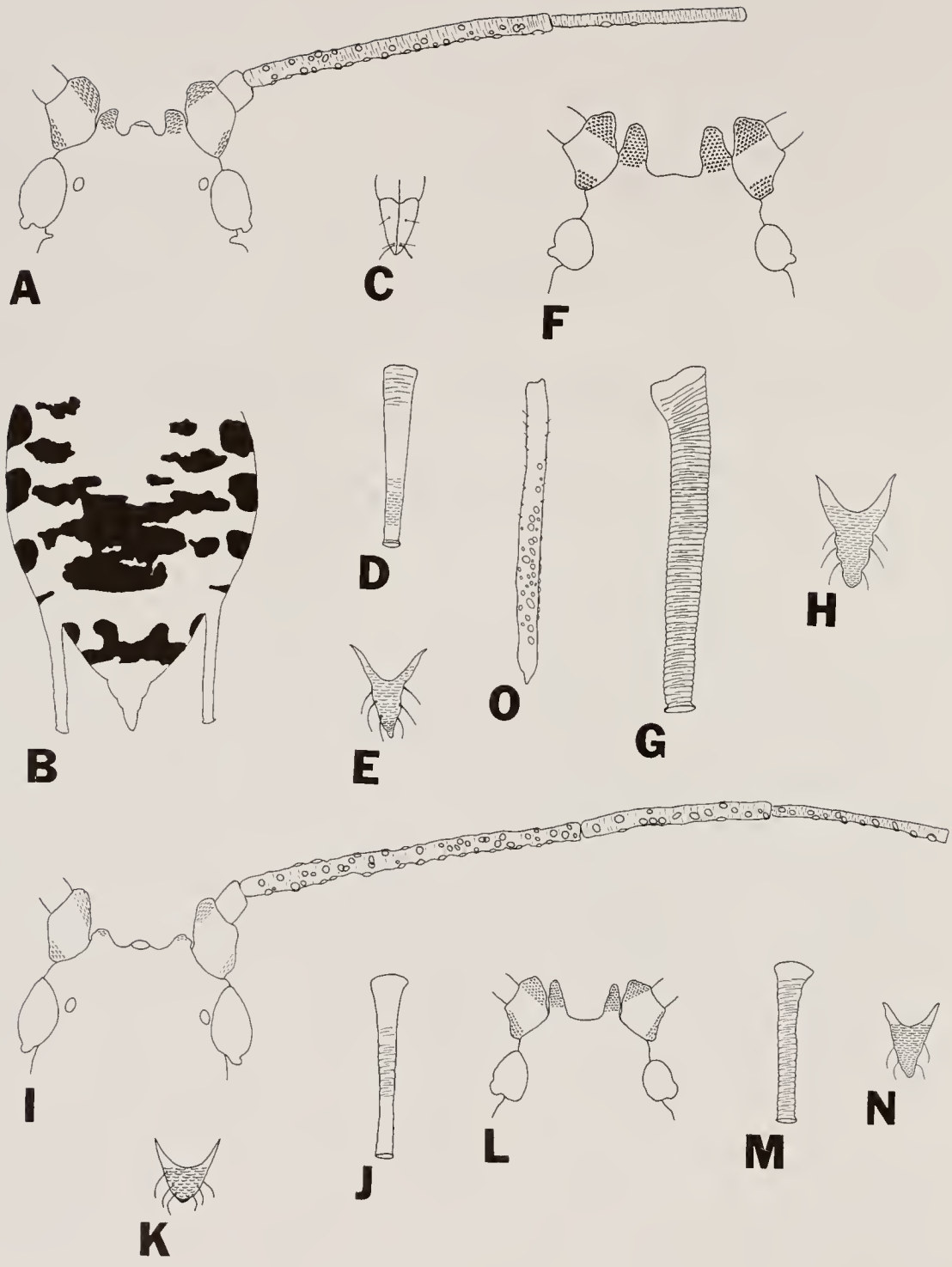

Figure 7

GENUS *HYALOMYZUS* RICHARDS

Hyalomyzus Richards 1958: 169
Ovatus (*Hyalomyzus*) van der Goot. Quednau 1966: 426.

Eastop (1966), in his discussion of the genus *Ovatus*, stated that he suspected *Utamphorophora* Knowlton and *Hyalomyzus* Richards to be North American subgenera of *Ovatus* van der Goot. Quednau (1966) listed *Hyalomyzus* as a subgenus of *Ovatus*. The genus *Hyalomyzus* is without doubt closely related to *Ovatus*, particularly *eriobotryae* which has a pattern of host alternation similar to species of *Ovatus*. In *Hyalomyzus*, the general body color is brownish amber, the cornicles are swollen and the cycle is between *Crataegus* (and other Rosaceae) and Labiatae (Verbenaceae) or Onagraceae (Hypericaceae), while in *Ovatus* the body color is green, the cornicles are cylindrical and the cycle is between *Crataegus* and Labiatae. Because swollen cornicles are more advanced than cylindrical ones (Hille Ris Lambers, 1949, discussion of *Hyperomyzus* and *Nasonovia*) and because of the greater host range of its species *Hyalomyzus* is considered to be more advanced than *Ovatus* and probably derived from it. However, since the Onagraceae are in no way related to the Labiatae, I regard *Hyalomyzus* to be a group biologically and morphologically distinct from *Ovatus*. *H. eriobotryae*, which is biologically similar in some respects to species of *Ovatus*, is retained in *Hyalomyzus* because of the obvious morphological similarities.

Characteristics. Frontal tubercles very prominent, parallel to strongly converging and scabrous. Ventral tubercles, scabrous evaginations of the frons laterad to the base of the rostrum, well developed (absent in sensoriatus). Alate viviparae with many secondary sensoria on segments III, IV and also usually on V. Rostral segment III with 2 pairs of lateral setae. Veins of forewing with narrow fuscous borders; venation normal, except hindwing of tissoti Nielsson and Habeck in which Cu_2 is usually partially or wholly absent. Setal formula of first tarsal segments 3:3:3. Alate viviparae without a dorsal sclerotic patch on the abdomen. Abdomen of apterous viviparae strongly wrinkled on segments I-VI. Cornicles well developed, cylindrical to swollen, smooth (in alate viviparae) to strongly imbricated (in apterous viviparae).

Type. Myzus eriobotryae Tissot.

Distribution. Nearctic.

Key to Eastern U.S. Species of Hyalomyzus

1. Terminal filament less than 3 times as long as base of antennal segment VI; base of antennal segment VI more than 1.5 times as long as rostral IV + V; ventral tubercles absent from head.....sensoriatus
   Terminal filament more than 3 times as long as base of antennal segment VI; base of antennal segment VI less than 1.3 times as long as rostral IV + V; ventral tubercles present on head (Fig. 8H).....2
2. Antennal segment III of alate viviparae with 35 or more sensoria; abdominal segment VIII with 4 dorsal setae; alternating between Rosaceae and Labiatae or Verbenaceae.....eriobotryae

Antennal segment III of alate viviparae with less than 30 sensoria; abdominal segment VIII with 2 or 3 dorsal setae; alternating between Rosaceae and Onagraceae, or anholocyclic on the latter..... 3

3. Abdominal segment VIII with 3 dorsal setae; in alate viviparae lateral abdominal sclerites I-IV each with 1 seta; hind wing with both oblique veins present; anholocyclic on Jussiaea; known only from Puerto Rico.....jussiaeae

Abdominal segment VIII with 2, or rarely 3 or 4, dorsal setae; in alate viviparae some lateral abdominal sclerites, most frequently II and III, with 2, or rarely 3, setae; hing wing with 1 oblique vein reduced or absent, rarely with both oblique veins either wholly present or absent; alternating between Crataegus and Isnardi (and Drosera); known only from Florida.....tissoti

Hyalomyzus eriobotryae (Tissot)

Figure 8, A-H

Myzus eriobotryae Tissot 1935:49-52.
Micromyzus collinsoniae Pepper 1950: 13-4
Hyalomyzus eriobotryae (Tissot). Richards 1958: 169-72.
Hyalomyzus collinsoniae (Pepper). Pepper 1965: 201.

Hyalomyzus collinsoniae (Pepper) was placed in synoymy with eriobotryae by Nielsson and Habeck (1971).

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens brown. Antennal segments I, II and base of III brown, remainder of III and IV-VI black. Narrow band of fuscous alongside veins of forewing. Abdomen yellowish brown to brown with dark brown lateral sclerites, cauda yellowish brown, cornicles, and anal and genital plates dark brown.

Morphology. Body length 1.27-2.25. Frontal tubercles moderately prominent, strongly converging, scabrous. Setae on head and antennae pointed, ventral tubercles present on head. Antennae longer than body with 35-64 sensoria on

III, 13-41 on IV, and 1-25 on V in addition to the primary sensorium. Lengths of antennal segments: III, 0.46-0.68; IV, 0.31-0.54; V, 0.25-0.44; VI 0.10-0.15 + 0.46-0.75. Head width through eyes 0.37-0.46. Rostrum extends behind hind coxae; apical segment 0.108-0.140 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.063-0.104 long. Lateral tubercles on abdominal segments III and IV and sometimes on II; 1 seta on lateral sclerites on II and V, 1 or 2 on III and 2 on IV; segment VII with 4 dorsal setae and usually with 2 dorsal tubercles between the 2 middorsal setae; VIII with 4 dorsal setae. Cornicles 0.25-0.45 long, slightly swollen, smooth to weakly imbricated. Cauda 0.12-0.21 long, conical, very slightly constricted medially, with 5-6 lateral setae. Anal plate with 8-15 setae evenly distributed. Genital plate with 2, rarely 3, setae on anterior edge and 7-12 along posterior edge, rarely with 1 or 2 in center of plate.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens brown. Lateral sclerites absent, otherwise like alate viviparae.

Morphology. Body length 1.06-1.92. Frontal tubercles very prominent, strongly converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae longer than body, secondary sensoria absent. Lengths of antennal segments: III, 0.29-0.52; IV, 0.20-0.42; V, 0.20-0.36; VI, 0.11-0.15 + 0.38-0.62. Apical rostral

segment 0.099-0.135 long. Head width through eyes 0.32-0.47. Second hind tarsal 0.061-0.115 long. Lateral abdominal tubercles sometimes on II, III and/or IV. Dorsum of abdomen sclerotic, very weakly pigmented, strongly wrinkled except on segments VII and VIII; VII usually with 4 dorsal setae and with 1 or 2 tubercles between the 2 middorsal setae, sometimes with 5 dorsal setae and no tubercles; VIII with 4 dorsal setae. Cornicles 0.26-0.42 long, distinctly swollen, strongly imbricated. Cauda 0.10-0.18 long, conical, constricted medially, with 4-6 setae. Anal plate with 6-12 setae evenly distributed. Genital plate with 2, rarely 3, setae on anterior edge and 6-9 along posterior edge, rarely with 1 in center of plate. Other features similar to alate viviparae.

MALE. Generally similar to alate viviparous female, but sensoria smaller and usually more numerous, 53-72 on III, 24-45 on IV, and 11-19 on V in addition to the primary sensorium. Cauda 0.10-0.13 long, with 6, rarely 7, setae.

OVIPAROUS FEMALE. Essentially the same as apterous viviparous female. Hind tibia swollen, with pseudosensoria along entire length (Richards 1958).

Types. Holotype and allotype in the USNM. Paratypes in the USNM and FSCA.

Distribution. Nearctic. Eastern U. S.: Widespread.

Collections studied. CONNECTICUT: Short Beach, 20 Aug. 1959 (Smith, Tuatay, and Kring), Crataegus sp.

PENNSYLVANIA: Clearfield, 9 June 1962, (J. O. Pepper), Crataegus sp.; Phillipsburg, 20 May 1962, same data; State College, 26 Aug. 1946 (J. O. Pepper), Collinsonia canadensis L.; 7 Aug. 1950, same data; 25 Aug. 1950, same data; 30 Aug. 1950, same data; 7 Sept. 1964, same data. MARYLAND: Beltsville, 12 Oct. 1940 (L. J. Bottimer), Crataegus sp. NORTH CAROLINA: Laurel Springs, 2 June 1961, (C. F. and C. K. Smith), crabapple; McCready, 10 Sept. 1963 (J. O. Pepper), Collisonia canadensis L.; Raleigh, 24 Apr. 1959 (C. F. Smith), apple; 29 Apr. 1959, same data; 3 May 1959, same data; 27 May 1959 (C. F. Smith), Crataegus sp.; 12 Nov. 1959 (C. F. Smith), Labiatae; Dec. 1959, same data; 12 Jan. 1960 (C. F. Smith), Lycopus virginicus L.; 22 Jan. 1960, same data; 31 May 1961 (C. F. Smith), Crataegus sp.; Wilkesboro, 9 Sept. 1963 (Smith, Pepper, and Tissot), Collinsonia sp. FLORIDA: Gainesville, 4 Dec. 1928 (A. N. Tissot), Eriobotrya japonica (Thunb.) Lindl.; 7 Dec. 1928 (A. N. Tissot), apple; 27 Dec. 1928 (A. N. Tissot), Eriobotrya japonica (Thunb.) Lindl.; 19 Feb. 1929 (A. N. Tissot), Crataegus sp.; 30 Dec. 1931 (A. N. Tissot), E. japonica (Thunb.) Lindl.; 19 Dec. 1935 (G. F. Weber and A. N. Tissot), Koellia sp. (= Pycnanthemum sp.) ; 16 Apr. 1936 (A. N. Tissot), Gelsemium sempervirens (L.) Ait. f.; 25 Mar. 1937 (A. N. Tissot), Crataegus uniflora Moench.; 12 Apr. 1937, same data; 9 Apr. 1941, same data; 14 Apr. 1941, same data; 30 Mar. 1942 (A. N. Tissot), Crataegus amica Beadle, C. dapsilis Beadle, C. floridana

Sarg., C. limnophiloides Murrill, C. newelliana Murrill, C. ravenelli Sarg., C. rimosa Beadle, C. rimosiformis Murrill, C. subaudens Murrill, C. subflavida Murrill, C. subpaludosa Murrill, C. subviridis Beadle, and C. visendiformis Murrill. LOUISIANA: Lafayette, 6 Apr. 1937 (D. C. Elliott), Crataegus sp. USNM, FSCA, CFS, HBB, JOP.

Biology. Richards (1958) suggests an alternation between Crataegus, Eriobotrya, or Malus and some semi-aquatic plant since Stroyan (1955) collected specimens with Acidaphium cuspidati Stroyan on waterlogged mosses. However, Stroyan does not mention H. eriobotryae in the paper.

I believe the collection records indicate that the alternation is between the Rosaceous primary hosts and Labiatae and occasionally Verbenaceae. Viviparae have been collected on primary hosts from December to May in Florida, November to April in North Carolina, May and June in Pennsylvania and September and October in Ontario (Richards 1958); males have been collected in December in Florida and in September and October, with oviparae, in Ontario (Richards 1958). Viviparae have been collected on secondary hosts in December in Florida, September to January in North Carolina and August and September in Pennsylvania.

Distinguishing characteristics. Antennal tubercles very prominent, strongly converging, scabrous; numerous sensoria on antennal segments III-V in alates; lateral

sclerites on abdominal III and/or IV with 2, rarely 3, setae; cornicles of apterae distinctly swollen; cauda with 5-6 setae.

This species is very close to H. jussiaeae Smith and H. tissoti Nielsson and Habeck. In jussiaeae all the lateral abdominal sclerites have only 1 seta and the sensoria are less numerous. H. tissoti is a smaller aphid with fewer sensoria and Cu2 in the hind wing is generally partially or wholly absent.

Hyalomyzus jussiaeae Smith

Hyalomyzus jussiaeae Smith 1960: 160-1.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens brownish amber. General color of cleared specimens light brown. Head and thorax light brown; base of antennal segment III pale; I, II and remainder of III concolorous with head; IV-VI pale brown. Base of femur and middle 3/4 of tibia pale, apex of tibia and tarsus light brownish black; rest of legs concolorous with thorax. Abdomen pale, lateral sclerites light brown. Cornicles pale basally, light brown at apex; cauda pale; anal and genital plates light brown.

Morphology. Body length 1.26-1.67. Frontal tubercles very prominent, converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Ventral tubercles present on head. Antennae longer than body with 30-36 sensoria on III, 12-19 on IV, and 3-8 on V in addition to the primary sensorium. Lengths of antennal segments: III, 0.40-0.47; IV, 0.25-0.37; V, 0.25-0.31; VI 0.12-0.14 +

Figure 8.--*Hyalomyzus eriobotryae* (Tissot), A-H. A-D, alate viviparous female: A, head and antennal segments I-V; B, rostrum; C, cornicle; D, cauda; E-G, apterous viviparous female: E, head; F, cornicle; G, cauda; H, ventral tubercles on head (1/2 scale). *H. sensoriatus* (Mason) plesiotypes, I-O. I-L, alate viviparous female: I, head and antennal segments I-V; J, rostrum; K, cornicle; L, cauda; M-O, apterous viviparous female; M, head; N, cornicle; O, cauda.

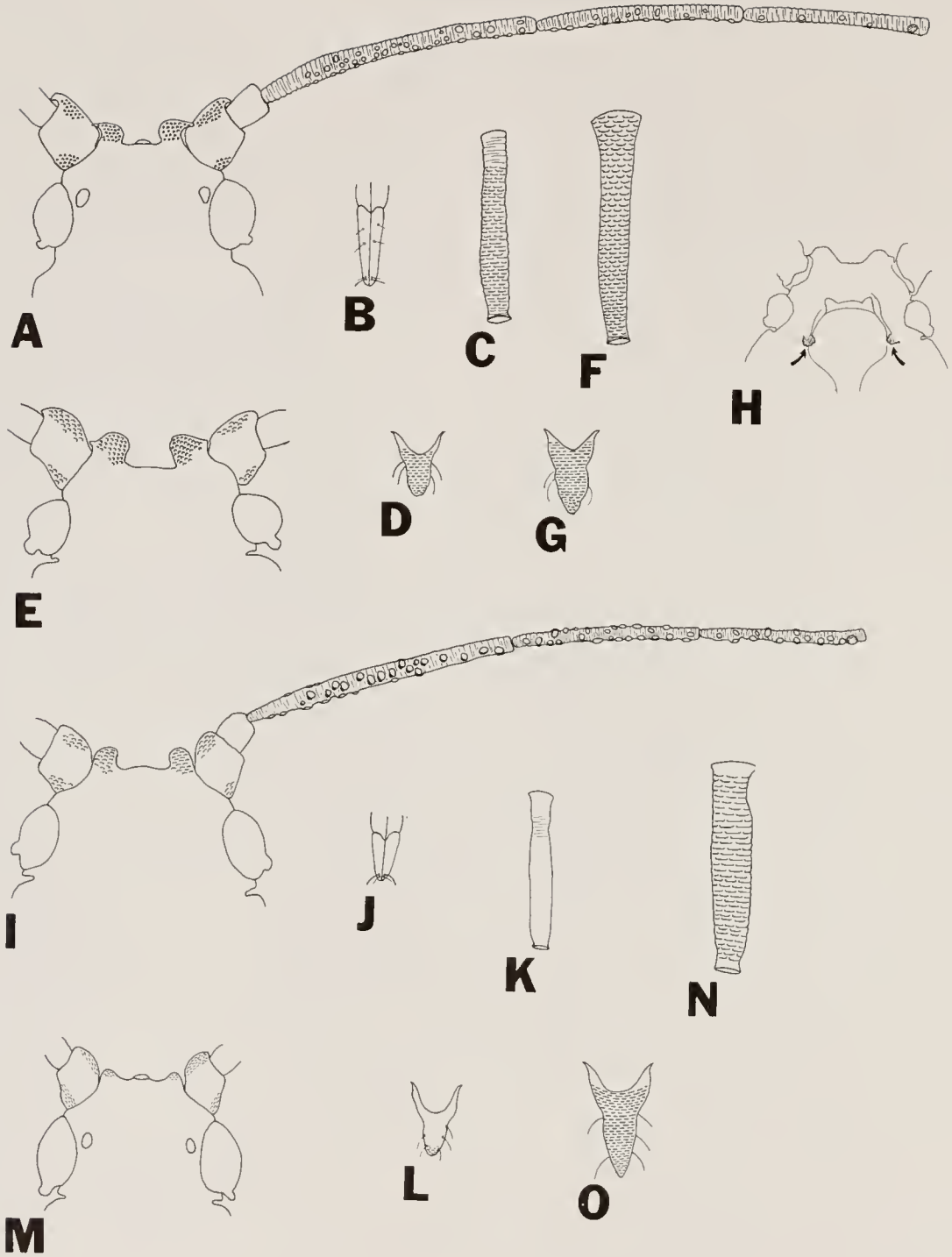

Figure 8

0.55-0.66. Head width through eyes 0.39-0.42. Rostrum extends beyond hind coxae; apical segment 0.140-0.158 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.083-0.099 long. Wing venation normal, veins of forewings with fuscous borders. Lateral abdominal tubercles usually on segments III and/or IV and occasionally also on II. Lateral abdominal sclerites on segments I-V with 1 seta each. Segment VII with 4 dorsal setae and usually with 1 or 2 tubercles between the 2 middorsal setae; VIII with 3 dorsal setae, arranged 1 on 1 side and 2 on the other. Cornicle 0.28-0.33 long, cylindrical to slightly swollen, weakly to moderately imbricated. Cauda 0.12-0.13 long, conical, slightly constricted medially, with 2 pairs of lateral setae. Anal plate with 8-10 setae evenly distributed. Genital plate with 2 setae anteriorly and 7-9 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens dirty greenish brown with a reddish area around cornicles. General color of cleared specimens pale brown. Antennal segment III yellowish brown; I, II, IV, and V brownish amber; VI brown. Apices of tibiae and tarsi brown, rest of legs yellowish brown. Lateral sclerites absent. Otherwise, similar to alate viviparae.

Morphology. Body length 1.12-1.90. Frontal tubercles very prominent, converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae longer than

body, secondary sensoria absent. Lengths of antennal segments: III, 0.33-0.51; IV, 0.21-0.41; V, 0.20-0.35; VI, 0.11-0.14 + 0.46-0.64. Head width through eyes 0.35-0.43. Rostrum extends beyond hind coxae, apical segment 0.128-0.146 long. Second hind tarsal segment 0.086-0.099 long. Dorsum of abdomen sclerotic, weakly pigmented, very strongly wrinkled except on segments VII and VIII; abdominal tubercles usually absent. Cornicles 0.30-0.42 long, slightly swollen, strongly imbricated. Cauda 0.12-0.13 long, conical, slightly constricted medially, with 2 pairs of lateral setae. Other features similar to alate viviparae.

Sexual forms are unknown.

Types. Holotype in USNM. Paracolonotypes in USNM, Agricultural Experiment Station of the University of Puerto Rico, FSCA, CFS and HRL. Paratypes in the Agricultural Experiment Station of the University of Puerto Rico and CFS.

Distribution. Puerto Rico.

Collections studied. All in Puerto Rico on Jussiaea angustifolia Lam. Dona Juaña, 26 Apr. 1960 (C. F. Smith); El Yunque, 1 Apr. 1967 (Smith and Perez); 7 Mar. 1969 (Smith and Martorell); Maricao Forest, 11 Mar. 1955 (C. F. Smith); Naranjito, 30 Apr. 1960 (C. F. Smith); Orocovis, 7 Apr. 1967 (Smith and Perez); Utuado, 11 Mar. 1969. (Smith and Martorell). USNM, FSCA, CFS.

Biology. All specimens of this species have been collected on Jussiaea angustifolia Lam. even though Britton

and Wilson (1924) list apple and loquat as moderately abundant in Puerto Rico. Therefore it is believed that this species is anholocyclic on Jussiaea.

Distinguishing characteristics. Lateral abdominal sclerites with 1 seta each; cauda with 2 pairs of lateral setae.

This species is very close to eriobotryae and tissoti; the means by which they can be separated are discussed under those species. This species is not figured separately because it so closely resembles eriobotryae.

Smith (1960) uses the character of the terminal filament distinctly longer than antennal III to separate jussiaeae from eriobotryae. This character is valid for paratype material of eriobotryae from Florida, but in the North the terminal filament is subequal to III and is sometimes shorter than III. In order to account for the variability of eriobotryae, only the numbers of sensoria and of lateral abdominal setae should be used as diagnostic characters.

Hyalomyzus sensoriatus (Mason)

Figure 8, I-O

Myzus sensoriatus Mason 1940: 19.
Hyalomyzus sensoriatus (Mason). Richards 1958: 172. tentative assignment.
Ovatus (Hyalomyzus) sensoriatus (Mason). Quednau 1966: 426.
Hyalomyzus sensoriatus (Mason). Nielsson and Habeck 1971.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens brown. Antenna pale to dusky; thorax brownish yellow with greenish tinge; legs dusky, tarsi

darker; abdomen pale greenish. General color of cleared specimens brownish amber; abdomen pale.

Morphology. (On Crataegus, from Mason 1940). Antennae shorter than body; segment III with 45-62 very tuberculate sensoria, IV with 27-43, V with 12-17. Lengths of antennal segments: III, 0.45-0.56; IV, 0.26-0.46; V, 0.20-0.38; VI, 0.10-0.15 + 0.21-0.28. Head width through eyes 0.36-0.40. Cornicles 0.28-0.33 long, slightly swollen, smooth. Cauda 0.09 long, conical, slightly constricted medially, with 2 pairs of lateral setae.

(On Hypericum). Body length 1.15-1.36. Frontal tubercles not prominent, parallel to slightly converging, scabrous. Setae on head and antennae pointed, inconspicuous. Ventral tubercles on head absent. Antennae longer than body with 32-42 sensoria on III, 20-27 on IV, and 12-20 on V in addition to the primary sensorium; sensoria not noticeably tuberculate. Lengths of antennal segments: III, 0.42-0.49; IV, 0.28-0.32; V, 0.26-0.29; VI 0.11-0.14 + 0.20-0.31. Head width through eyes 0.34-0.39. Rostrum reaches middle coxae; apical segment 0.058-0.068 long, with only the 3 apical pairs of setae. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.086-0.094 long. Wing venation normal. Abdominal tubercles absent. Segments VII and VIII each with 4 dorsal setae. Cornicle 0.24-0.26 long, slightly swollen, smooth. Cauda 0.12-0.13 long, conical, slightly constricted medially, with 2 pairs of lateral setae, rarely with an additional

terminal seta. Anal plate with 7-12 setae evenly distributed. Genital plate with 2, rarely 3, setae anteriorly and 5-8 along posterior edge, rarely with an additional seta in the center of the plate.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens light amber; lateral sclerites absent, otherwise like alate viviparae.

Morphology. (On Hypericum) Body length 0.90-1.26. Antennae subequal to body length, secondary sensoria absent. Lengths of antennal segments: III, 0.19-0.31; IV, 0.14-0.23; V, 0.14-0.23; VI 0.09-0.12 + 0.17-0.22. Head width through eyes 0.31-0.35. Apical rostral segment 0.058-0.068 long. Second hind tarsal segment 0.083-0.086 long. Dorsum of abdomen sclerotic, very weakly pigmented, strongly wrinkled except on segments VII and VIII; VII and VIII with 4 setae each; tubercles absent. Cornicles 0.26-0.30 long, swollen, smooth to weakly imbricated. Cauda 0.13-0.14 long, conical, slightly constricted medially, with 3-4 lateral setae. Other features similar to alate viviparae.

Sexual forms are unknown.

Types. Lectotype, paralectotype and morphotype in USNM. Plesiotypes in USNM and JOP.

Distribution. Washington, D. C., Pennsylvania.

Collections studied. WASHINGTON, D. C.: Chain Bridge, 14 May 1906 (T. Pergande), Crataegus crusgalli L. PENNSYLVANIA: Cook's Forest, 28 June 1958 (J. C. Pepper), Hypericum sp.;

Hyner, 1 July 1958, same data; Kane, 28 June 1942, same data; Parker Dam, 18 Aug. 1962 (J. O. Pepper), Aster sp.; State College, 13 July 1958 (J. O. Pepper), Hypericum sp; 30 June 1962, same data. USNM, JOP.

Biology. This species alternates between Crataegus and Hypericum presumably overwintering on the former and migrating to the latter in May-June, although sexual forms are presently unknown.

Distinguishing characteristics. Terminal filament subequal to twice the length of the base of antennal segment VI; ventral tubercles on head and tubercles on abdomen absent; rostral IV + V with only the 3 apical pairs of setae.

Hyalomyzus tissoti Nielsson and Habeck

Hyalomyzus tissoti Nielsson and Habeck 1971.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens brown. Head brown; antennal segments I, II and base of III brown, remainder of III and IV-VI black; thorax brown; wings hyaline, veins dark brown with narrow band of shading alongside veins of forewing, stigma dark brown; legs with femora yellow basally, brown distally, tibiae yellowish brown with black apices, tarsi black; abdomen yellowish brown to brown with dark brown lateral sclerites; cauda yellowish brown; cornicles and anal and genital plates dark brown.

Morphology. Body length 1.00-1.53. Frontal tubercles very prominent, parallel to slightly converging, scabrous. Setae on head and antennae pointed, inconspicuous. Ventral tubercles present on head. Antennae longer than body, with 11-25 sensoria on III, 1-11 on IV, and 0-3 on V in addition to the primary sensorium. Lengths of antennal segments: III, 0.31-0.42; IV, 0.22-0.34; V, 0.20-0.26; VI 0.10-0.13 + 0.47-0.60. Head width through eyes 0.35-0.41. Rostrum extends beyond hind coxae; apical segment 0.130-0.142 long, with 1 pair of setae in addition to the usual 3 apical pairs; ventral pair of apical setae usually removed basad from other 2 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.076-0.090 long. Hind wing with one oblique vein reduced or absent, rarely with both veins either present or absent. Lateral tubercles usually on abdominal segments III and IV and occasionally also on II. Segment VII with 4 dorsal setae and usually with 2 dorsal tubercles between the 2 middorsal setae; VIII with 2, rarely 3 or 4, setae. Cornicle 0.23-0.28 long, cylindrical to slightly swollen, smooth to weakly imbricated. Cauda 0.08-0.14 long, blunt, not or rarely slightly constricted medially, with 2 pairs of lateral setae. Anal plate with 8-11 setae evenly distributed. Genital plate with 2 setae anteriorly and 5-7 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens brown; lateral sclerites absent; otherwise like alate viviparae.

Morphology. Body length 1.06-1.35. Frontal tubercles very prominent, converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae longer than body, secondary sensoria absent. Lengths of antennal segments; III, 0.27-0.40; IV, 0.18-0.29; V, 0.20-0.28; VI, 0.10-0.13 + 0.49-0.52. Head width through eyes 0.33-0.42. Rostrum extends beyond hind coxae, apical segment 0.124-0.146 long. Second hind tarsal segment 0.074-0.094 long. Dorsum of abdomen sclerotic, very weakly pigmented, strongly wrinkled except on segments VII and VIII; VII with 4 dorsal setae and frequently with 2 dorsal tubercles between the 2 middorsal setae; VIII with 2 setae. Cornicle 0.27-0.36 long, cylindrical to slightly swollen, strongly imbricated. Cauda 0.11-0.16 long, blunt, slightly constricted medially, with 2 setae on each side or rarely with 1 or 3 on 1 side and 2 on the other. Other features similar to alate viviparae.

Sexual forms are unknown.

Types. Holotype and morphotype in USNM. Paratypes in USNM and FSCA.

Distribution. North Peninsular Florida.

Collections studied. FLORIDA: Gainesville, 30 Mar. 1942 (A. N. Tissot), Crataegus praeformosa Murrill and C. vicana Beadle; 19 Mar. 1970 (R. J. Nielsson), Drosera sp.; Otter Creek, 2 Apr. 1936 (E. West and A. N. Tissot), on Drosera capillaris Poir.; Polk Co., 5 Feb. 1946 (E. West), Isnardia intermedia Small and Alexander. USNM, FSCA.

Biology. This species alternates between Crataegus and Isnardia. It is also found on sundew (Drosera sp.)

but only for a short period in early spring and it is believed that this is not an essential host in the seasonal history of the species.

Distinguishing characteristics. Small size, reduced numbers of sensoria, Cu_2 in hind wing partially or wholly absent, ventral pair of 3 apical pairs of setae on apical rostral segment removed basad from the tip giving the impression of 2 lateral pairs and only 2 apical pairs. This species is very similar to eriobotryae and jussiaeae. However, both of the latter species are larger with more sensoria, have Cu_2 in the hind wing always present and the apical rostral segment has the usual arrangement of 1 lateral and 3 apical pairs of setae. H. tissoti is not figured separately because it so closely resembles eriobotryae.

GENUS OVATUS VAN DER GOOT

Ovatus van der Goot 1912: 64.
Ovatophorodon Aizenberg 1966: 151-2.

This genus has generally been accepted as a valid group, distinct from Phorodon in the structure of the antennal tubercles but otherwise similar to it, even though the type species has been placed by various authors in Myzus (Takahashi 1923, Theobald 1919) and in Phorodon (Borner 1926, Theobald 1926). Aizenberg (1966) even used the type species, Siphonophora menthae Buckton (= crataegaria Walker), as the type of Ovatophorodon n. gen., differing from Ovatus in the degree of development of the antennal tubercles. Therefore, Ovatophorodon Aizenberg is a full synonym of Ovatus van der Goot.

Aizenberg (1966) stated that the evolution of this genus is synchronous with the evolutionary division of the Prunoidea and Pomoidea, Phorodon occurring on the former and Ovatus on the latter.

Characteristics. Antennal tubercles well developed, converging, scabrous. Alate viviparae with sensoria in a straight line on antennal segment III, or with numerous sensoria on segments III and IV (and V); secondary sensoria absent in apterae. Rostral segment III with 2 pairs of lateral setae. Abdomen without a dorsal sclerotic patch.

Cornicles cylindrical, sometimes constricted medially (phloxae), imbricated, without apical reticulations.

Type. Aphis crataegaria Walker.

Distribution. Holarctic, Oriental, Ethiopian.

Key to Eastern U.S. Species of Ovatus

1. Alate viviparae with numberous sensoria scattered over segment III and frequently a few also present on IV and V; cornicles of alatae and apterae cylindrical .....crataegarius
   Alate viviparae with sensoria present only on antennal segment III, in approximately a straight row; cornicles of alatae and apterae constricted medially.....phloxae

Ovatus crataegarius (Walker)

Figure 9, A-G

Aphis crataegaria Walker 1850: 46.
Aphis melissae Walker 1852: 1037.
Aphis menthae Walker 1852: 1045.
Siphonophora menthae Buckton 1876: 120.
Macrosiphum menthae (Buckton). Schouteden 1901: 116.
Myzus mespili van der Goot 1912: 64.
Phorodon menthae (Buckton). van der Goot 1915: 134. - Gillette and Palmer 1934: 208 - Sampson 1939: 174.
Myzus mespiliella Theobald 1920: 153.
Myzus menthae (Buckton). Takahashi 1923: 22.
Phorodon crataegi Börner 1926: 227.
Phorodon mespili (van der Goot). Theobald 1926: 364.
Aphis crataegella Theobald 1927: 206, in part.
Ovatus menthae (Buckton). Hille Ris Lambers 1947b: 306.
Ovatus crataegarius (Walker). Börner 1952b: 122. - Heinze 1960: 825. - Doncaster 1961: 50-2.
Ovatophorodon menthae (Buckton). Aizenberg 1966: 136, 151-2.

This species is 1 of 3 morphologically similar species which vary biologically. Aizenberg (1966) assumed that Siphonophora menthae Buckton and Ovatus menthastri Hille Ris Lambers (1947b, p. 303) were the same species and designated S. menthae Buckton as the type of his new genus Ovatophorodon. However, Ovatus menthastri is autoecious

with sexulaes on Mentha spp., quite different from the biological pattern of menthae Buckton, a synonym of crataegarius Walker. Therefore, Ovatophorodon Aizenberg, type Siphonophora menthae Buckton, is a full synonym of Ovatus.

ALATE VIVPAROUS FEMALE. Coloration. General color of living specimens pale green. General color of mounted specimens amber. Head and antennal segments I and II amber, segments III-VI brownish amber. Basal 1/4 of femur pale, apex amber. Tibia amber, its apex and tarsus brownish amber. Lateral abdominal sclerites brown on a pale background; segment VII brown dorsally. Cornicles, cauda, and anal and gential plates brownish amber.

Morphology. Body length 1.45-1.73. Antennal tubercles moderately prominent, parallel to slightly diverging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae longer than body, with 18-41 scattered sensoria on segment III, 0-11 on IV and 0-2 on V in addition to the primary sensorium. Lengths of antennal segments: III, 0.39-0.55; IV, 0.29-0.35; V, 0.28-0.33; VI, 0.11-0.12 + 0.54-0.61. Head width through eyes 0.36-0.43. Rostrum reaches middle coxae; apical segment 0.135-0.140 long, with 2-3 lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.083-0.106. Veins of forewing narrowly outlined with fuscous borders. Abdomen with lateral sclerites on segments II-IV, presiphuncular sclerite on V,

postsiphuncular sclerite on VI; tergum of segment VII wholly sclerotic. Lateral tubercles usually absent, on segment IV when present. Dorsal tubercles absent. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.27-0.34 long, cylindrical, weakly imbricated. Cauda 0.13-0.18 long, conical, not constricted, with 4-5 lateral setae and occasionally with 1-2 preapical setae. Anal plate with 8-12 setae evenly distributed. Genital plate with 2 setae anteriorly and 7-12 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens pale green. General color of mounted specimens yellowish amber. Head and antennal segments I, II and base of III pale; apex of III and IV-VI brown. Femur pale. Tibia amber; its apex and tarsus brownish amber. Abdomen pale. Cornicles pale basally, brownish amber apically. Cauda and anal and genital plates light yellowish amber.

Morphology. Body length 1.24-1.35. Antennal tubercles very prominent converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae longer than body; secondary sensoria absent. Lengths of antennal segments: III, 0.35-0.41; IV, 0.25-0.26; V, 0.24-0.25; VI, 0.09-0.11 + 0.47-0.54. Head width through eyes 0.35-0.40. Rostrum surpasses hind coxae; apical segment 0.124-0.135 long, with 2-4 lateral setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.083-0.106 long. Abdominal sclerites and tubercles absent. Segments VII and

VIII each with 4 dorsal setae. Cornicles 0.31-0.35 long, cylindrical, moderately imbricated. Cauda 0.10-0.17 long, subtriangular, with 2 pairs of lateral setae and 0-2 preapical setae. Setae on anal and genital plates as in alate viviparae.

No sexual forms were available for study, and from a review of the literature, I believe that they have not been described.

Types. In the British Museum.

Distribution. Holarctic, Oriental, Ethiopian. Eastern U. S.: Widespread.

Collections studied. PENNSYLVANIA: State College, 25 Aug. 1960 (J. O. Pepper), spearmint; 20 Aug. 1961 (J. O. Pepper), Mentha spicata L. INDIANA: 8 Aug. 1933 (G. E. Gould), peppermint. MARYLAND: College Park, 20 June 1902 (T. Pergande), mint; 2 June 1961 (C. W. McComb), mint; Westgate, 8 June 1960 (E. Hambledon), mint. NORTH CAROLINA: Raleigh, 7 Dec. 1963 (C. F. Smith), mint. CALIFORNIA: Berkeley, 30 Mar. 1935 (E. O. Essig), Mentha spicata L. USNM, CFS.

Leonard (1963) records this species from the following states in the Eastern U. S.: Maine, Massachusetts, Connecticut, Michigan, New York, Pennsylvania, Indiana, Illinois, New Jersey, Washington, D. C., North Carolina and Virginia.

Biology. Although the biology of this species has not been thoroughly studied, it is known that they hibernate

Figure 9.--Ovatus crataegarius (Walker), A-G. A-D, alate viviparous female: A, head and antennal segments I-IV; B, rostrum; C, cornicle; D, cauda; E-G, apterous viviparous female: E, head; F, cornicle; G, cauda. O. phloxae (Sampson), H-O. H-L, alate viviparous female: H, head and antennal segments I-III; I, sclerotic pattern on abdomen (1/2 scale); J, rostrum; K, cornicle; L, cauda; M-O, apterous viviparous female: M, head; N, cornicle; O, cauda.

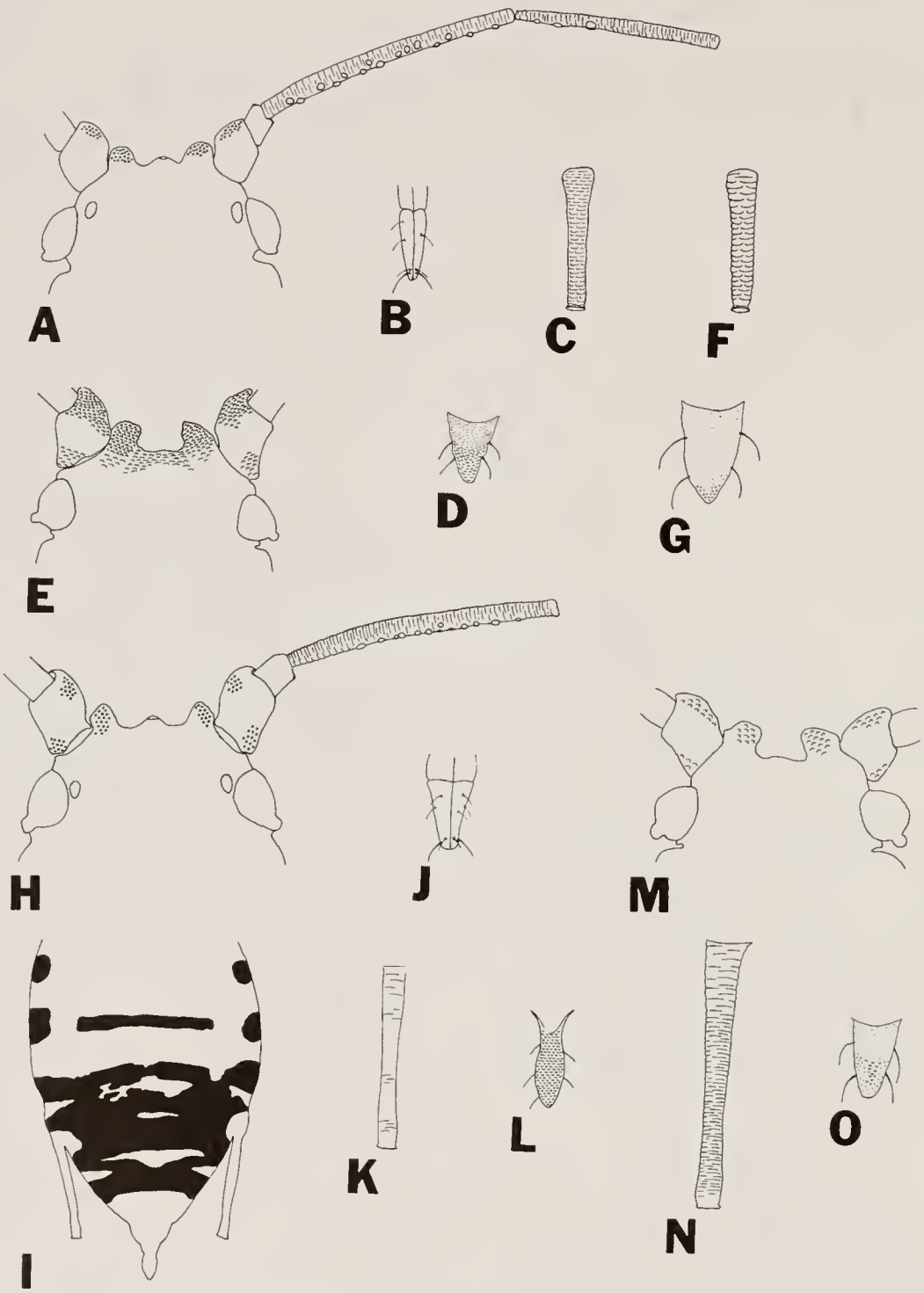

Figure 9

as eggs on Crataegus spp., and sometimes on apple and Cydonia spp., and migrate to Mentha spp. in the summer (Hille Ris Lambers 1947b).

Distinguishing characteristics. Alate viviparae with numerous sensoria on antennal segment III, and usually a few also present on IV and V. Dorsal sclerotic patch absent. Cornicles cylindrical.

Ovatus phloxae (Sampson)

Figure 9, H-O

Myzus plantagineus Davis nec Passerini 1910: 495.
Myzus plantagineus Williams nec Passerini 1910: 149.
Phorodon phloxae Sampson 1939: 174-5.
Ovatus phloxae (Sampson). Hille Ris Lambers 1966: 600.

The synonymy of this species was thoroughly discussed by Hille Ris Lambers (1966).

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens green. General color of mounted specimens amber. Head and antennal segments I and II amber. Base of segment III pale; rest of III and IV-VI yellowish amber. Basal 1/3-1/2 of femur yellow, apex amber. Tibia yellow; its apex and tarsus amber. Lateral abdominal sclerites brown on a pale background. Cornicles, cauda, and anal and genital plates yellowish amber.

Morphology. Body length 1.40-1.44. Antennal tubercles moderately prominent, parallel to slightly diverging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae longer than body, with 12-14 sensoria in a more or

less straight row on segment III. Lengths of antennal segments: III, 0.35-0.39; IV, 0.26-0.27; V, 0.27-0.29; VI, 0.13-0.15 + 0.48-0.50. Head width through eyes 0.35-0.37. Rostrum surpasses middle coxae; apical segment 0.101-0.106 long, with 2 pairs of lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.090-0.095 long. Abdomen with lateral sclerites on segments II-IV, presiphuncular sclerite on V and postsiphuncular sclerite on VI. Dorsal transverse sclerotic bars on IV-VII; on IV-VI, fused into a loose patch. Abdominal tubercles absent. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.29-0.31 long, cylindrical, slightly constricted medially, moderately imbricated. Cauda 0.12-0.14 long, elongated and conical, with 2-3 pairs of lateral setae. Anal plate with 14-18 setae evenly distributed. Genital plate with 2 setae anteriorly and 8-10 along posterior edge, occasionally with 1-3 setae in the center of the plate.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens light green. General color of mounted specimens amber. Head and antennal segments I and II amber. Segment III, basal 3/4 of IV and basal 1/2 of V pale; rest of IV and V and all of VI amber. Femur amber. Tibia yellow; its apex and tarsus brown. Cornicles pale. Cauda and anal and genital plates yellow to yellowish amber.

Morphology. Body length 1.16-1.51. Antennal tubercles very prominent, converging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae longer than body, without secondary sensoria. Lengths of antennal segments: III, 0.32-0.34; IV, 0.22-0.25; V, 0.23-0.26; VI, 0.12-0.13 + 0.39-0.46. Head width through eyes 0.34-0.40. Rostrum surpasses hind coxae; apical segment 0.101-0.113 long, with 2-5 lateral setae and 0-2 surface setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.090-0.095 long. Abdominal sclerites and tubercles absent. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.36-0.40 long, cylindrical, slightly constricted medially moderately imbricated. Cauda 0.14-0.17 long, conical, with obtuse apex, with 2 pairs of lateral setae and occasionally an additional preapical seta. Setae on anal and genital plates as in alate viviparae.

Sexual forms are not known.

Types. In the California Academy of Science collection.

Distribution. Nearctic. Eastern U.S.: Pennsylvania, Washington, D. C., Virginia.

Collections studied. PENNSYLVANIA: State College, 5 June 1960 (J. O. Pepper), Plantago major L.; Woodward, 2 July 1960, same data. WASHINGTON, D. C.: Chain Bridge, 25 Aug. 1959 (C. F. Smith), plantain. VIRGINIA: Vienna, 18 May 1915 (A. C. Baker), plantain; 22 May 1915, same data; 28 May 1915; same data; 4 June 1915, same data. USNM, CFS, JOP.

Biology. The biology of this species has not been studied. It is abundant on Plantago and has also been collected on Phlox and Polygonum in California. Hille Ris Lambers (1966) stated that phloxae either has a wide variety of host plants or is part of a complex, the members of which infest several host plants.

Distinguishing characteristics. Alate viviparous female with sensoria on antennal segment III in approximately a straight row. Dorsal sclerotic patch present on abdominal segments IV-VI with transverse bars on III and VII. Cornicles cylindrical and slightly constricted medially.

GENUS UTAMPHOROPHORA KNOWLTON

Utamphorophora Knowlton 1946: 1.
Ovatus (Utamphorophora) van der Goot. Eastop 1966: 468.

The genus Ovatus van der Goot is primarily associated with Pomoideae and migrates to Labiatae, or is anholcyclic on the latter. However, Utamphorophora alternates between Rosaceae and Graminae. Morphologically secondary sensoria are absent in apterous Ovatus but are frequently present in Utamphorophora. Therefore I consider this latter genus to be biologically and morphologically distinct from Ovatus and so treat it thus.

The description which Knowlton (1946) gives for this genus is very brief, and, aside from the character of Phorodon-like projections on the antennal tubercles, contains little in the way of diagnostic characters. In paratypes of humboldti examined, the Phorodon-like projections are frequently absent and are always absent in specimens examined from the Eastern United States. Therefore, the following redefinition is presented:

Antennal tubercles moderately prominent, parallel, slightly scabrous in alate viviparae; in apterous viviparae, very prominent, strongly converging, and scabrous and sometimes with finger-like projections resembling those in

Phorodon. Antennae slightly longer than body in alate viviparae, distinctly shorter in apterous viviparae; alate viviparae with sensoria on segment III or on III, IV (and V); apterous viviparae with 0-3, usually 2, sensoria basally on segment III. Rostrum short, not reaching the middle coxae; apical segment obtuse, shorter than second hind tarsal segment. Rostral segment III with 2 pairs of lateral setae. Setal formula of first tarsal segments 3:3:3. Wing venation normal. Abdomen of alate viviparae with pleural pigmented patches between the lateral sclerites, and sometimes a dorsal pigmented area connecting the pleural patches on segments IV-VI; abdomen of apterous viviparae without pigmented areas. Cornicles swollen, smooth to moderately imbricated. Cauda elongate, conical, basally constricted. Males alate.

Type. Utamphorophora timpanogos Knowlton 1946.

Hille Ris Lambers (1952b) stated that his new genus Sitomyzus is related to Amphorophora. Since S. columbiae is a synonym of U. humboldti, it would seem that the genus Utamphorophora should be placed in the Macrosiphini. In the alatae of humboldti, the antennal tubercles are not prominent, parallel and only very slightly scabrous, and in spring apterae are diverging. However, the antennal tubercles of fall apterae and oviparae are typical of the Myzini, very prominent, converging and scabrous, and may sometimes bear secondary projections similar to those in Phorodon. In addition, the rostrum, tarsal setae, and cauda are typical for the Myzini. The presence of sensoria

on antennal segment III of the apterae presents no argument to this classification since they are also present in apterae of Aulacorthum and Rhodobium.

One species occurs in the Eastern United States, Utamphorophora humboldti (Essig).

Utamphorophora humboldti (Essig)

Figure 10

Myzus humboldti Essig 1941: 182-4.
Myzus physocarpi Pepper 1950: 8-9
Sitomyzus columbiae Richards 1960: 774-5.
Hyalomyzus physocarpi (Pepper). Pepper 1965: 201.
Utamphorophora humboldti (Essig). Hille Ris Lambers 1966: 619.

The synonymy of this species was thoroughly discussed by Hille Ris Lambers (1966).

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens brown. General color of mounted specimens brown. Head, thorax, rostrum and antennae brown. Femora pale basally, shading to dark brown apically; tibiae light brown basally, dark brown apically, light yellowish brown on middle 2/3; tarsi brown. Wing veins yellowish brown to brown. Lateral sclerites, pleural spots, and dorsal patch (when present) on the abdomen, cornicles, and genital plate brown. Cauda very light brown. Anal plate yellowish brown.

Morphology. Spring migrants. Body length 1.06-1.37. Antennal tubercles moderately prominent, parallel, slightly scabrous. Setae on head and antennae pointed, inconspicuous. Antennae slightly longer than body, with 8-19 sensoria on

segment III, confined mainly to the basal 1/2 of the segment; and with 0-4, usually 0, apically on IV. Lengths of antennal segments: III, 0.43-0.57; IV, 0.27-0.37; V, 0.26-0.34; VI, 0.13-0.16 + 0.48-0.65. Head width through eyes 0.40-0.44. Rostrum does not reach middle coxae; apical segment 0.083-0.095 long, distinctly shorter than second hind tarsal segment, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.087-0.112 long. Lateral tubercles usually on abdominal segments III and IV and occasionally also on II. Abdominal segment VII with 2 dorsal setae, VIII with 4. Cornicles 0.33-0.41 long, swollen, smooth to very weakly imbricated. Cauda 0.15-0.20 long, elongate conical, basally constricted, with 2 pairs of lateral setae and frequently with an additional terminal seta. Anal plate with 14-17 setae evenly distributed. Genital plate with 2 setae anteriorly and 5-10 along posterior edge.

Fall migrants. Antennal segment III with 28-47 sensoria, IV with 4-16 which are confined mainly to the apical 1/2 of the segment, and V with 0-10 in addition to the primary sensorium. Length of antennal segments: III, 0.50-0.60; IV, 0.27-0.39; V, 0.22-0.34; VI, 0.13-0.19 + 0.59-0.66. Lateral abdominal tubercles only occasionally present. Otherwise the same as spring migrant alatae.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color

of living specimens light brown. General color of mounted specimens pale to light yellowish amber. Antennal segment VI, apical rostral segment and tarsi light brown. Rest of body pale to light yellowish amber.

Morphology. Body length 1.72-2.10. Antennal tubercles very prominent, parallel in spring forms to converging in fall forms, scabrous, sometimes with secondary projections. Setae on head and antennae blunt to pointed, inconspicuous. Antennae distinctly shorter than body, with 0-3, usually 2, sensoria basally on segment III. Lengths of antennal segments: III, 0.35-0.44; IV, 0.17-0.25; V, 0.20-0.25; VI, 0.13-0.15 + 0.27-0.45. Head width through eyes 0.41-0.44. Rostrum does not or just barely reaches middle coxae; apical segment 0.083-0.094 long, with 1 pair of setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.104-0.112 long. Lateral abdominal sclerites and tubercles absent. Abdominal segment VII with 2 dorsal setae, VIII with 4. Cornicles 0.40-0.45 long, swollen, weakly imbricated. Cauda 0.20-0.22 long, blunt, with 2 pairs of lateral setae and frequently with an additional terminal seta. Anal plate with 10-12 setae evenly distributed. Genital plate with 2 setae anteriorly and 8-12 along posterior edge.

MALE. Generally similar to alate viviparous female. Antennal segment III with 42-65 moderately tuberculate

sensoria, IV with 9-14, V with 5-9 in addition to the primary sensorium. Cauda 0.09-0.11 long, blunt, with 4-5 setae terminally.

VIPAROUS FEMALE. Similar to apterous viviparae but smaller. Body length 1.42-1.70. Antennae slightly shorter than body, with 0-3, more frequently 1, sensoria basally on segment III. Lengths of antennal segments: III, 0.24-0.31; IV, 0.17-0.20; V, 0.17-0.20; VI, 0.08-0.12 + 0.29-0.36. Head width through eyes 0.30-0.38. Apical rostral segment 0.081-0.088 long. Hind tibia swollen, with 104-150 pseudosensoria over almost the entire length. Second hind tarsal segment 0.081-0.088 long. Cornicles 0.25-0.34 long, cylindrical to slightly swollen, moderately imbricated. Cauda 0.12-0.15 long, blunt. Genital plate with 2 setae anteriorly, 6-10 scattered over the center of the plate, and 19-28 along the posterior edge in 2-3 irregular rows. Other features as in apterous viviparae.

Types. Essig collection, University of California at Berkeley. Paratypes in the USNM, British Museum, and HRL. Plesiotypes (all collected on Physocarpus opulifolius (L.) Maxim.: 1 male and 4 oviparous females, Geneva, N. Y., 24 Oct. 1946 (P. J. Chapman); 13 males and 32 oviparous females, State College, Pa., 1 Nov. 1953 (J. O. Pepper), in USNM and JOP.

Distribution. Nearctic. Eastern U.S.: New Jersey, Pennsylvania.

Collections studied. In addition to the plesiotypes listed above, NEW JERSEY: Ridgewood, 26 Oct. 1935 (M. D. Leonard), Physocarpus opulifolius (L.) Maxim.; 2 Nov. 1935, same data; 22 May 1938, same data. PENNSYLVANIA: Lewiston, 28 May 1964 (J. O. Pepper), Physocarpus opulifolius (L.) Maxim.; Spruce Creek, 25 Apr. 1945, same data; State College, 20 May 1951, same data; 25 May 1958, same data; 14 May 1961. same data. NEW BRUNSWICK: Fredericton, 4 Sept. 1964 (J. Daley), Physocarpus sp. MANITOBA: Winnipeg, 5 July 1967 (A. G. Robinson), Physocarpus opulifolius (L.) Maxim. CALIFORNIA: Berkeley, 10 Nov. 1963 (Hille Ris Lambers), Polypogon monspeliensis (L.) Desf.; Trinidad, 2 June 1938 (E. O. Essig), Viburnum ellipticum Hook. USNM, FSCA, HRL, JOP.

Biology. Utamphorophora humboldti (Essig) alternates between Physocarpus, as its primary host, and various grasses as secondary hosts. Hille Ris Lambers (1966) states that Essig, according to a note in his collection, considered the specimens on Viburnum to be drifts. Subsequent collections were made at Berkeley, Cal., by Hille Ris Lambers on Physocarpus and on Polypogon monspeliensis (L.) Desf.

Distinguishing characteristics. Numerous secondary sensoria on antennal segments III, IV (V) of alate viviparae. Apterae with 0-3, usually 2, sensoria basally on segment III. Abdomen of alatae usually with a dorsal patch. Cornicles swollen.

Figure 10.--Utamphoroophora humboldti (Essig). A-E, alate viviparous female: A, head and antennal segments I-IV: B, sclerotic pattern on abdomen (1/2 scale); C, rostrum; D, cornicle; E, cauda; F-H, apterous viviparous female: F, head; G, cornicle; H, cauda; I-L, male: I, head and antennal segments I-V; J, sclerotic pattern on abdomen (1/2 scale); K, cornicle; L, cauda; M-N, oviparous female: M, head; N, hind tibia.

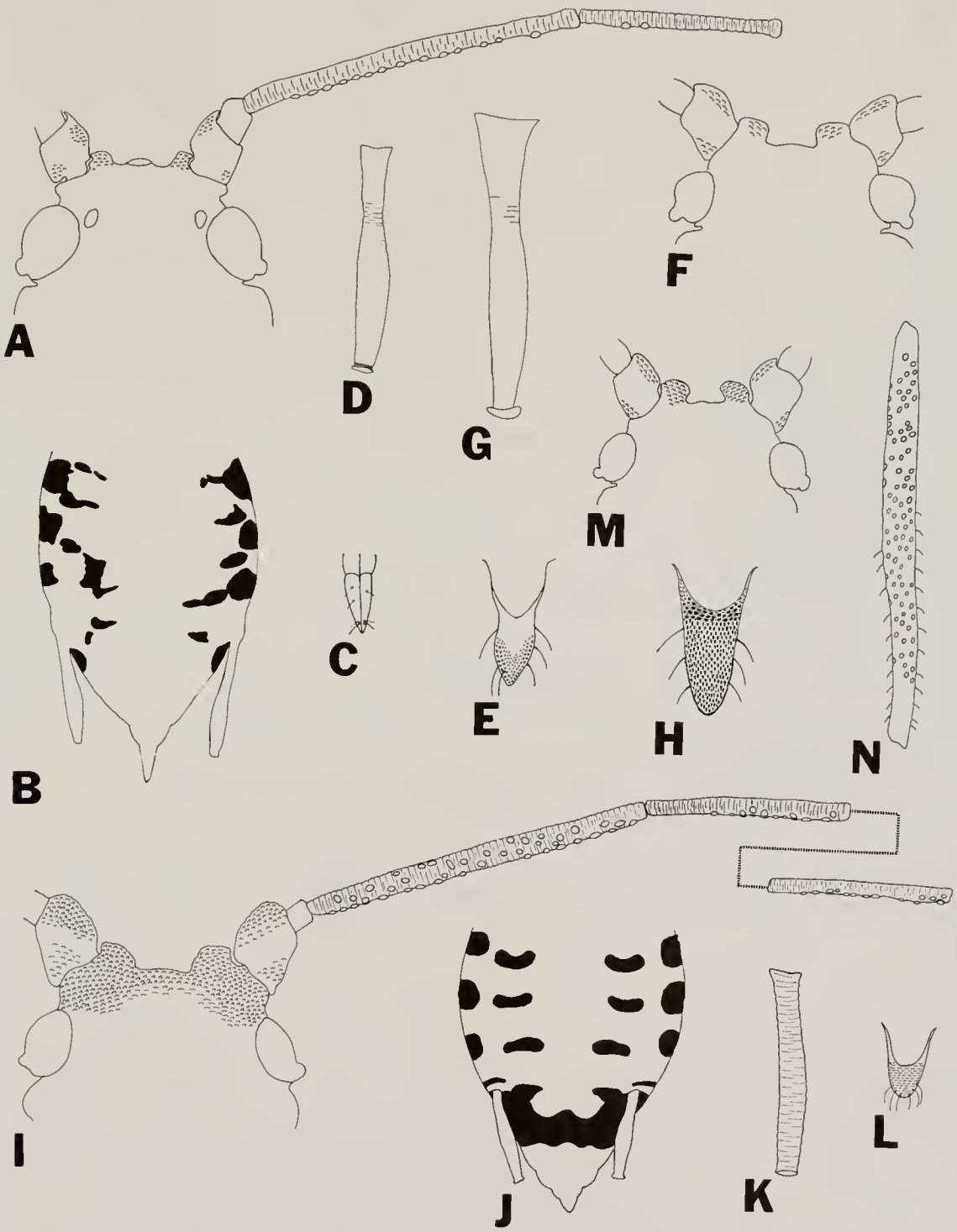

Figure 10

GENUS AULACORTHUM MORDWILKO

Aulacorthum Mordwilko 1914: 68. - van der Goot 1917: 20-1. - Hille Ris Lambers 1947a: 307-13.

The description of Aulacorthum by Mordwilko (1914) consisted of a key couplet on p. 68 and the type species was fixed as Aphis pelargonii Kaltenbach from a figure caption on p. 52. Van der Goot (1917) stated that he could not translate Mordwilko's paper but inferred from the above-mentioned figure that the genus was characterized by the peculiarly shaped frontal tubercles. Hille Ris Lambers (1947a) stated that Mordwilko's description was based on a misidentified specimen of Aphis solani Kaltenbach, since the true pelargonii Kalt. is an Acyrthosiphon.

Börner (1930) and Börner and Schilder (1932) placed Aulacorthum in the Amphorophorini, primarily because the type species had been misidentified originally. Mordwilko (1914) had placed this genus in the Myzini and this was supported by Hille Ris Lambers (1947a). However, Aizenberg (1966) considered Aulacorthum to be in the Macrosiphini, closely related to Neomyzus in the Myzini, and Hille Ris Lambers' (1949) placing Neomyzus as a subgenus of Aulacorthum he considered to be the only justification for placing the latter genus in the Myzini. However, the characteristics

of the antennal tubercles, antennal setae, and scabrous vertex are those of the Myzini, not of the Macrosiphini or Amphorophorini.

Characteristics. Antennal tubercles very prominent, parallel, scabrous. Alate viviparae with sensoria in a straight line on segment III and occasionally a few sensoria present on IV. Apterous viviparae with 0-6, usually 1-2, sensoria basally on III. Rostral segment III with at least 3 pairs of lateral setae. Abdomen usually with pigmented dorsal markings in alatae, in apterae present only in circumflexum. Cornicles long, cylindrical, tapered, frequently with a few rows of closed reticulations apically.

Type. Aphis solani Kaltenbach.

Distribution. Worldwide.

Key to Eastern U.S. Species of Aulacorthum

1. Alate viviparae never with sensoria on antennal segment IV; abdomen with transverse pigmented bars on the dorsum (Fig. 12). Apterae with 1-6, usually 2-3, sensoria basally on antennal segment III; dorsum of abdomen without a pigmented area .....solani

   Alate viviparae frequently with sensoria on antennal segment IV; abdomen with a rectangular pigmented patch on the dorsum (Fig. 11). Apterae with 0-2, usually 1, sensoria basally on antennal segment 3; dorsum of abdomen usually with a horseshoe-shaped pigmented area.....circumflexum

Aulacorthum circumflexum (Buckton)

Figure 11

Siphonophora circumflexa Buckton 1876: 130.
Nectarophora circumflexa (Buckton). Hunter 1901: 113.
Macrosiphum circumflexum (Buckton). Schouteden 1906: 238.

Myzus circumflexum (Buckton). Davis 1914: 121. - Theobald 1926: 331. - Essig 1947: 605.
Macrosiphum pelargonii var. circumflexa Buckton. van der Goot 1915: 82.
Neomyzus circumflexus (Buckton). van der Goot 1917: 50. - Blanchard 1922: 213. - Heinze 1961:26.
Amphorophora circumflexa (Buckton). Börner 1932: 624.
Aulacorthum (Neomyzus) circumflexum (Buckton). Hille Ris Lambers 1933: 174. - Hille Ris Lambers 1949: 198-201.

The synonymy of this species was thoroughly discussed by Hille Ris Lambers (1949).

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens dark green. General color of mounted specimens brown. Basal 3/4 of antennal segment V yellowish amber; head and rest of antennae brown. Wing veins brown with narrow fuscous borders. Basal 1/2 of femur yellow; its apex dark brown. Tibia yellow to yellowish amber; its apex and tarsus dark brown. Abdomen with central and lateral sclerites brown on a pale background. Cornicles, cauda, and anal and genital plates yellowish amber.

Morphology. Body length 1.03-2.34. Antennal tubercles moderately prominent, parallel, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae longer than body, with 10-21 sensoria in a straight row on segment III and 0-7 in a straight row on IV. Lengths of antennal segments: III, 0.39-0.60; IV, 0.33-0.43; V, 0.23-0.42; VI, 0.14-0.17 + 0.42-0.59. Head width through eyes 0.36-0.43. Rostrum reaches middle coxae; apical segment 0.108-0.112 long, with 2 pairs of lateral setae and 2 surface setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.074-0.126

long. Abdomen with pigmented central sclerite on V continuous medially with the postsiphuncular sclerite on VI. Lateral tubercles present on segments II-IV. Dorsal tubercles occasionally present on VIII. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.23-0.53 long, cylindrical, weakly imbricated and with 2-3 rows of closed reticulations apically. Cauda 0.13-0.28 long, elongated and conical, not constricted, with 4-6 lateral setae and occasionally an additional preapical seta. Anal plate with 14-20 setae evenly distributed. Genital plate with 2 setae anteriorly and 14-20 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens green. General body color of mounted specimens yellowish amber. Dorsal patch on abdomen dark brown.

Morphology. Body length 1.19-1.85. Antennal tubercles very prominent, parallel, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae longer than body, with 0-2, usually 1, sensoria basally on segment III. Lengths of antennal segments: III, 0.50-0.58; IV, 0.38-0.45; V, 0.31-0.36; VI 0.16-0.18 + 0.41-0.83. Head width through eyes 0.39-0.46. Rostrum surpasses middle coxae; apical segment 0.108-0.113 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.083-0.099 long. Abdomen with dorsal u-shaped patch on segments II-V. Lateral sclerites and abdominal tubercles absent.

0.34-0.44 long, cylindrical, tapered, weakly imbricated, and with 2-3 rows of closed reticulations apically. Cauda 0.16-0.22 long, with 4-5 lateral setae and occasionally an additional preapical seta. Setae on anal and genital plates as in alate viviparae.

Sexual forms are not known.

Types. In the British Museum.

Distribution. Worldwide. Eastern U. S.: Widespread.

Collections examined. I examined specimens from most of the states in the Eastern U. S. Because this species is so polyphagous, the collection records are reduced to a list of plants, by families, on which it was collected. ARACEAE: Caladium sp., Calla sp., Pothos sp., Spathicarpa sp.; BEGONIACEAE: Begonia sp.; CAPRIFOLIACEAE: Viburnum tomentosum Thunb.; CARYOPHYLLACEAE: Dianthus sp., Oxalis sp.; CELASTRACEAE: Euonymous americanus L.; Euonymous sp.; COMPOSITAE: Chrysanthemum sp., Cineraria sp., Dahlia variabilis Desf., Dahlia sp., Echinops sp.; ERICACEAE: Andromeda sp., Erica sp.; GENTIANACEAE: Gentiana sp.; GESNERIACEAE: Saintpaulia sp.; HELIOTROPIACEAE: Heliotropium sp.; IRIDACEAE: Freesia sp., Gladiolous sp.; LABIATAE: Mentha sp., Salvia sp.; LILIACEAE: Helleborus sp., Easter lily - Lilium longiflorum Thunb., tulip - L. sylvestris L., hyacinth - Musari racemosum (L.) Mill.; MARCGRAVIACEAE: Marcgravia sp.; ONAGRACEAE: Fuchsia sp.; ORCHIDACEAE: Cypripedium sp., Dendrobium sp., Miltonia sp., Pleiona sp., Trichocereus sp.; PRIMULACEAE: Cyclamen sp., Primula sp.;

ROSACEAE: Prunus sp., Rosa sp.; RUTACEAE: lime - Citrus aurantifolia (Christm.) Swingle, Poncirus trifoliata (L.) Raf.; SAXIFRAGACEAE: Hydrangea sp., Philadelphus sp.; SPIGELIACEAE: Buddleia davidii Franch. USNM, FSCA, CFS.

See also Hille Ris Lambers (1949).

Biology. This species lives parthenogenetically throughout the year on plants in greenhouses, and in the field in subtropical and tropical climates. Alates are seldom produced and sexual forms do not occur (Hille Ris Lambers 1949).

Distinguishing characteristics. Alates usually with sensoria on antennal segment IV. Apterae with 0-2, usually 1, sensoria basally on segment III, and with a u-shaped patch dorsally on the abdomen. Cornicles with closed reticulations apically.

Aulacorthum solani (Kaltenbach)

Figure 12

Aphis solani Kaltenbach 1843: 15.
Aphis convolvuli Kaltenbach 1843: 40.
Aphis vincae Walker 1848: 429.
Macrosiphum veronicae Theobald 1913: 93.
Myzus pseudolamii Theobald 1915: 274. - 1926: 345.
Myzus piceaellus Theobald 1916: 146. - 1926: 315.
Myzus primulana Matsumura 1917: 400.
Myzus gei Theobald 1919: 157. - 1926: 349.
Myzus mercurialis Theoblad 1919: 158. - 1926: 350.
Myzus glaucii Theobald 1923: 103. - 1926: 350.
Myzus hydrocotylei Theobald 1925: 73. - 1926: 335.
Macrosiphum matsumureanum Hori 1926: 52.
Myzus chelidonii Kalt. nec Buckt. Theobald 1926: 336.
Myzus neogei Theobald 1926: 349.
Myzus polyanthi Theobald 1926: 341.
Myzus pseudosolani Theobald 1926: 313. - Gillette and Palmer 1934: 206.
Myzus veronicellus Theobald 1926: 347.
Macrosiphum aucubae Bartholomew 1932: 723.
Myzus solani (Kalt.). Essig 1947: 607.
Acyrthosiphon (Aulacorthum) solani (Kalt.). Eastop 1966: 426.

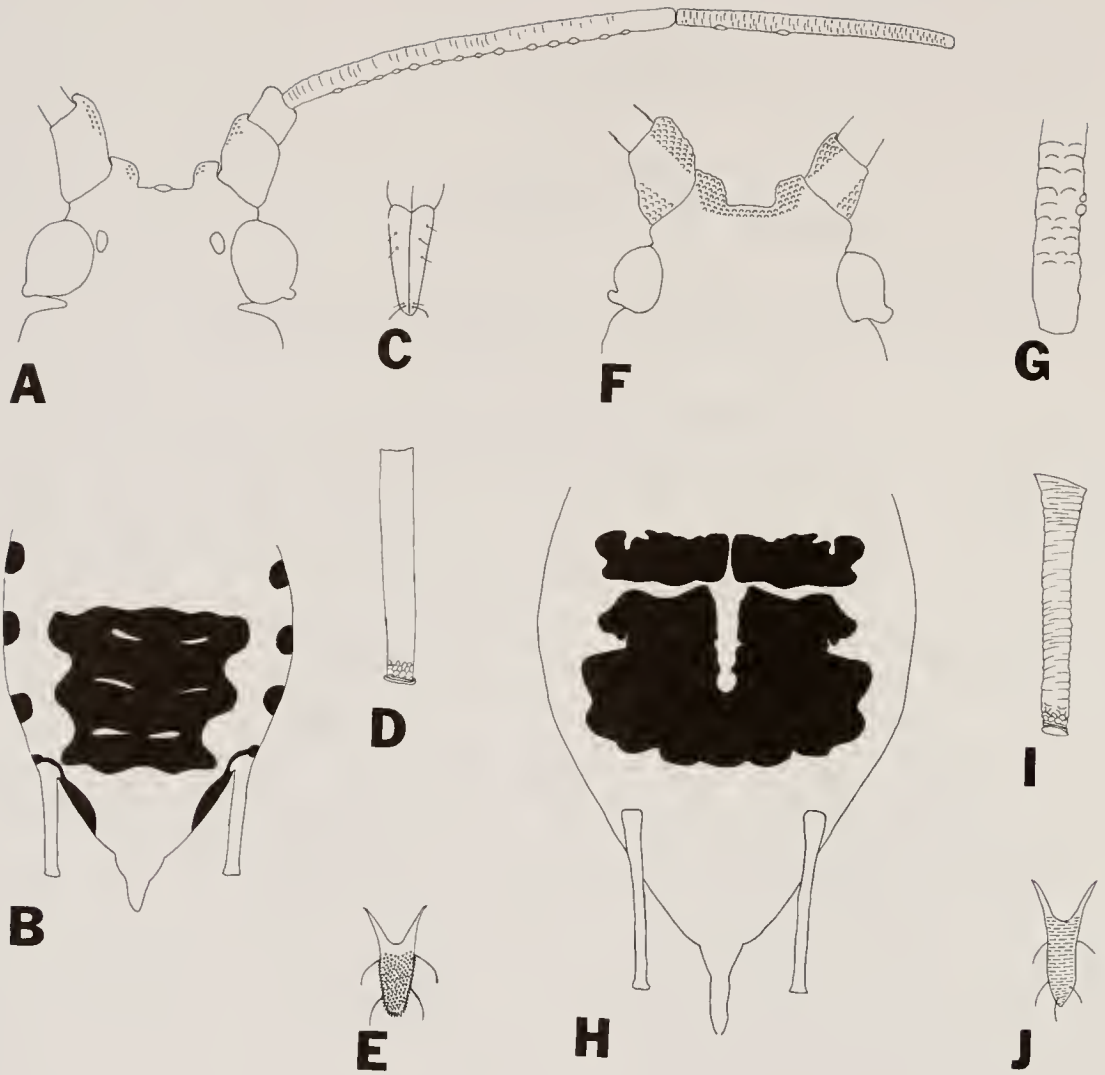

Figure 11.--Aulacorthum circumflexum (Buckton). A-E, alate viviparous female: A, head and antennal segments I-IV; B, sclerotic pattern on abdomen (1/2 scale); C, rostrum (2 x scale); D, cornicle, E, cauda; F-J, apterous viviparous female: F, head; G, base of antennal segment III (2 x scale); H, sclerotic pattern on abdomen (1/2 scale); I, cornicle; J, cauda.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens dark green. General color of mounted specimens brownish amber. Base of antennal segment III pale; head and rest of antennae amber- brown. Basal 1/2 of femur yellow, its apex brownish amber. Tibia yellow; its apex and tarsus brownish amber. Transverse pigmented areas dorsally on abdomen and lateral sclerites brown on a pale background. Cornicles amber. Cauda and anal and genital plates brownish amber.

Morphology. Body length 1.74-2.65. Antennal tubercles moderately prominent, parallel to diverging, weakly scabrous. Setae on head and antennae pointed; on head, length equal to basal diameter of antennal segment III; on antennae, inconspicuous. Antennae longer than body, with 10-16 sensoria in a straight row on segment III. Lengths of antennal segments: III, 0.61-0.76; IV 0.48-0.67; V, 0.44-0.57; VI, 0.19-0.23 + 0.83-1.04. Head width through eyes 0.45-0.50. Rostrum reaches middle coxae; apical segment 0.142-0.162 long, with 2 pairs of lateral setae and 1-2 surface setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.101-0.142 long. Abdomen with a bilateral series of dorsal and pleural patches, connected to each other on segments I and II forming transverse bars on each side and on III and IV are joined to the lateral sclerites and are continuous across the dorsum (Fig. 12). Segment V with a

median transverse bar between the bases of the cornicles; VI with medial extensions of the postsiphuncular sclerite which do not join dorsally; and, VII and VIII are wholly sclerotic and pigmented dorsally. Lateral tubercles occasionally on segments III and IV. Dorsal tubercles absent. Segment VII with 2 dorsal setae; VIII with 4. Cornicles 0.42-0.68 long, cylindrical, tapered, weakly imbricated, with 3 rows of closed reticulations apically. Cauda 0.19-0.25 long, elongate conical, not constricted, with 3 pairs of lateral setae and occasionally with an additional preapical seta. Anal plate with 12-16 setae evenly distributed. Genital plate with 2 setae anteriorly and 8-12 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens green. General color of mounted specimens light amber. Apex of antennal segments III-V, segment VI, apices of femur and tibia, tarsus, and apex of cornicles dark brown; rest of specimen light amber.

Morphology. Body length 1.55-2.15. Antennal tubercles very prominent, parallel to diverging, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae longer than body, with 1-4, usually 2, sensoria basally on segment III. Lengths of antennal segments: III, 0.58-0.75; IV, 0.39-0.65; V, 0.35-0.55; VI, 0.15-0.21 + 0.67-0.83. Head width through eyes 0.45-0.50. Rostrum surpasses middle coxae; apical segment 0.137-0.155 long, with 3-5 lateral setae and 1-3 surface setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.094-0.131

long. Lateral sclerites and abdominal tubercles absent. Segment VII with 2 dorsal setae; VIII with 4. Cornicles 0.44-0.73 long, cylindrical, tapered, moderately imbricated, with 0-2 rows of closed reticulations apically. Cauda 0.21-0.26 long, elongated and conical, not constricted, with 5-6 lateral setae and frequently with an additional preapical seta. Anal plate with 10-12 setae evenly distributed. Setae on genital plate as in alate viviparae.

Sexual forms were not available for study. The following descriptions are from Hille Ris Lambers (1949).

MALE. Apterous; otherwise similar to alate viviparous female. Antennal segment III with 27 scattered sensoria; IV with 5-7; V with 9-11 in addition to the primary sensorium. Cauda very short, blunt.

OVIPAROUS FEMALE. Essentially the same as apterous viviparous female. Hind tibiae dark and considerably swollen.

Types. Kaltenbach left no material. The types of Theobald's synonyms are in the British Museum. The type of matsumureanum Hori is in the collection of the Hokkaido Agricultural Experiment Station, Kotoni, Japan; metatypes are in the USNM.

Distribution. Holarctic, Neotropical and Australian. Eastern U.S.: Widespread.

Collections studied. NEW YORK: Ithaca, 4 Nov. 1926 (G. H. Griswold), Verbena hybrida Hort.; 28 Mar. 1928, (G. H. Griswold), tomato; 6 June 1938 (G. H. Griswold),

on potato. PENNSYLVANIA: State College, 17 May 1932 (J. O. Pepper), Marrubium vulgare L. MARYLAND: Baltimore, 27 May 1940 (L. J. Bottimer), Saxifraga virginiensis Michx. NORTH CAROLINA: Fletcher, 25 May 1960, light trap; Raleigh, 16 May 1958 (C. F. Smith), Sasangua sp; 14 June 1958 (C. F. Smith), African violet; 21 July 1958 (C. F. Smith), blackberry; 11 Oct. 1958 (Smith and Tuatay); 29 Sept. 1961, light trap; 2 June 1961 (C. F. Smith); 17 June 1961 (J. Graham), Ulmus fulva Michx.; 10 Sept. 1961 (C. F. Smith), Achillea sp.; 29 Sept. 1961 (C. F. Smith); 23 Oct. 1961 (C. F. Smith), Lycopus virginicus L.; Wilkesboro, 10 June 1960 (Smith and Tuatay). SOUTH CAROLINA: Anderson, 1 Mar. 1932 (A. Lutkin), periwinkle. FLORIDA: Gadsden Co., 22 Mar. 1948 (K. Dorward), tobacco; Gainesville, 21 Mar. 1937 (P. T. Riherd), potato; 20 Mar. 1941 (N. Carson), lettuce; 25 Mar. 1941 (A. N. Tissot), chickweed, Geranium carolinianum L., and Phlox drummondii Hook.; 6 Apr. 1941 (A. N. Tissot), chickweed, Gnaphalium obtusifolium L., and Plantago virginica L.; Hastings, 26 Mar. 1935 (G. F. Weber), Hydrocotyle umbellata L.; 1 Apr. 1935 (A. N. Tissot), H. umbellata L.; Jacksonville, 2 May 1960 Gloxinia sp.; Quincy, 4 Apr. 1957 (W. B. Tappan), vetch; Tampa, 23 Jan. 1950 (G. A. Buchanan), tulip. OREGON: Corvallis, 20 June 1951 (W. B. McHenry), lettuce; Seaside, 23 Apr. 1936 (K. Gray), pansy. CALIFORNIA: Arcadia, 13 Feb. 1969 (H. G. Walker), Cerastium tomentosum L.; 6 Apr. 1969 (H. G. Walker), Hagenia sp.; 8 Apr. 1969 Dianthus sp.; 3 June 1969 (H. G. Walker), Viola sp.; 12 Feb. 1970 (H. G. Walker), Dianthus chinensis L.; 13 Feb. 1970

(H. G. Walker), Hymenanthera sp. and Viola tricolor L.; 23 Feb. 1970 (H. G. Walker), Teucrium scorodonia L.; 26 Mar. 1970 (H. G. Walker), Salvia microphylla Hort.; 10 Nov. 1970 (H. G. Walker), Clerodendron nutans Hort. FSCA, CFS, HBB, HGW.

Biology. The biology of this species is not completely known. There is apparently no true primary host in its cycle but it can produce sexuals and overwinter as eggs on most of its host plants. It may also overwinter parthenogentically on plants in greenhouses and, in sub-tropical and tropical climates, in the field (Hille Ris Lambers 1949).

Distinguishing characteristics. Alate viviparae with several sensoria in a straight line on antennal segment III; apterous viviparae with 1-3, usually 2, sensoria basally on segment III. Abdomen of alate viviparae with a series of transverse pigmented bars. Cornicles long, cylindrical, slightly tapered, with 2-3 rows of closed reticulations apically.

Figure 12.--Aulacorthum solani (Kalt.). A-E, alate viviparous female: A, head and antennal segments I-III; B, sclerotic pattern on abdomen (1/2 scale); C, rostrum (2 x scale); D, cornicle; E, cauda; F-H, apterous viviparous female: F, head and antennal segments I-III; G, cornicle; H, cauda.

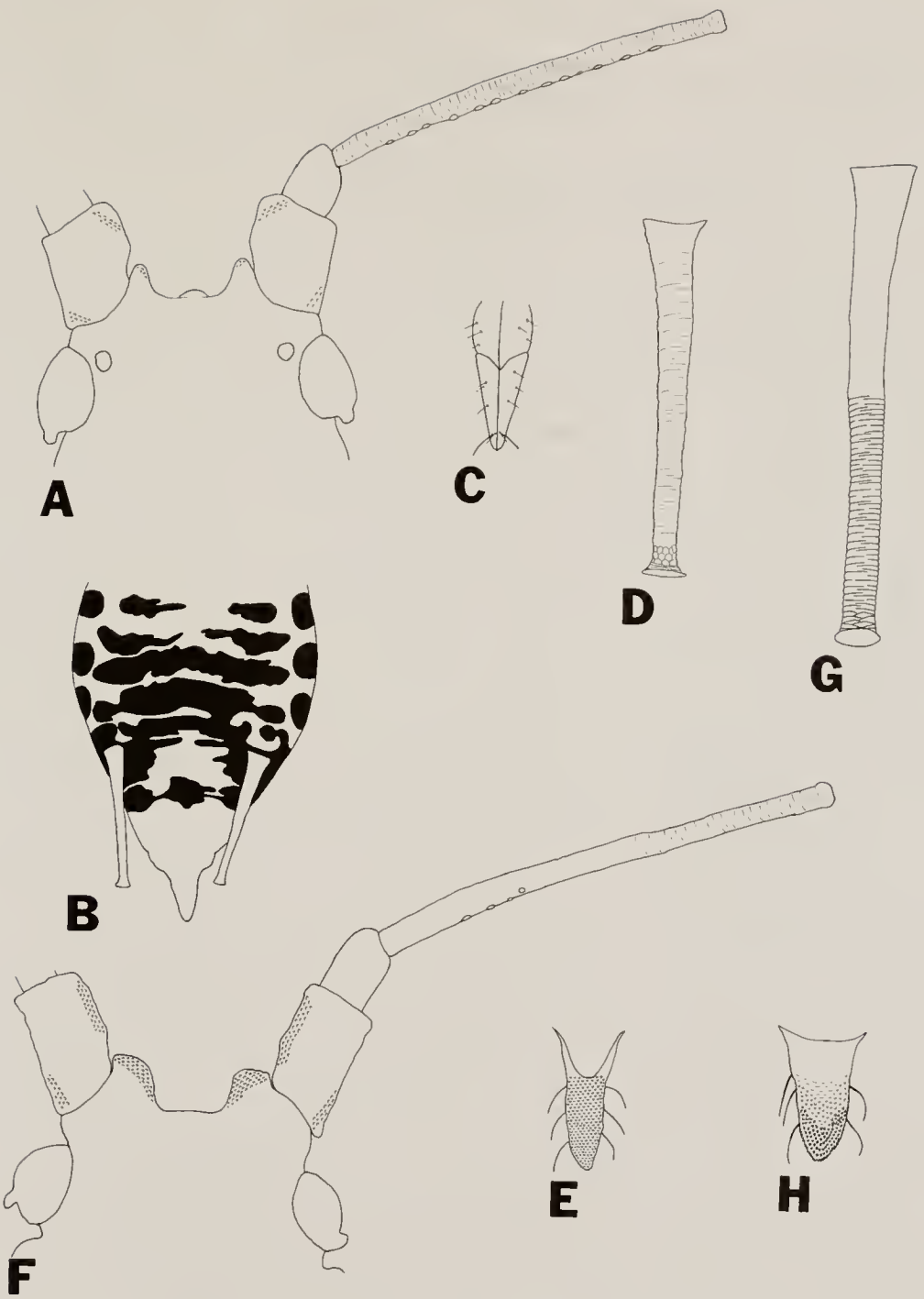

Figure 12

GENUS RHODOBIUM HILLE RIS LAMBERS

Rhodobium Hille Ris Lambers 1947a: 300-1.
Acyrthosiphon (Rhodobium) Mordw. Eastop 1966: 427.

Hille Ris Lambers (1947a) erected this genus for Macrosiphum rosaefolium Theobald (Myzus porosus Sanderson), which differs from Macrosiphum by the absence of apical reticulations on the cornicles, from Acyrthosiphon by the scabrous, converging antennal tubercles, and from Aulacorthum by the absence of a dorsal sclerotic area on the abdomen of alatae.

Rhodobium is here placed in the Myzini because of the characters of the frontal tubercles and cornicles mentioned above, even though it has affinities with the Macrosiphini in the size and shape of the cauda and the character of abdominal sclerotization.

Characteristics. Antennal tubercles well developed, slightly converging, scabrous. Alate viviparae with secondary sensoria on antennal segments III and IV; apterous viviparae with secondary sensoria the length of antennal segment III. Rostral segment III with a least 3 pairs of lateral setae. Abdomen without a central sclerotized patch. Cornicles cylindrical, imbricated, without apical reticulations.

Type. Myzus porosus Sanderson.

Distribution. Worldwide.

One species occurs in the Eastern United States, Rhodobium porosum Sanderson.

Rhodobium porosum (Sanderson)

Figure 13

Myzus porosus Sanderson 1901: 205. - Mason 1940: 15.
Macrosiphum rosaefolium Theobald 1915a: 109.
Aulacorthum viride van der Goot 1917: 31.
Aulacorthum pseudorosaefolium Blanchard 1922: 199-201.
Acyrthosiphon rosaefoliae Takahashi 1931: 64.
Rhodobium rosaefolium (Theobald). Hille Ris Lambers 1947a: 301-3.
Rhodobium porosus (Sanderson). Eastop 1953: 2-3.
Acyrthosiphon (Rhodobium) porosum (Sanderson). Eastop 1966: 427.

The synonymy of this species was discussed by Eastop (1953).

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens green. General color of mounted specimens brownish amber. Basal 3/4 of antennal segment IV yellow; head and rest of antennae brown. Basal 1/2 of femur yellow; its apex dark brown. Tibia yellow; its apex and tarsus brown. Lateral abdominal sclerites brown on a pale background. Cornicles brown. Cauda and anal and genital plates yellowish amber.

Morphology. Body length 1.49-1.95. Antennal tubercles very prominent, parallel to converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antenna longer than body, with 12-16 sensoria in a straight line on segment III and 4-7 on IV. Lengths of antennal segments: III, 0.49-0.62; IV, 0.30-0.41; V, 0.31-0.35; VI, 0.13-0.15 + 0.46-0.55. Head width through eyes 0.45-0.50. Rostrum does not reach middle coxae; apical segment 0.101-0.112 long, with 4-6 lateral setae and 1-3 surface setae in

addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.101-0.115 long. Abdomen with well developed lateral sclerities on II-IV, presiphuncular sclerite on V and postsiphuncular sclerite on VI-VII; dorsal sclerotic patch absent. Lateral tubercles on segments II-IV, occasionally on V, never on I. Dorsal tubercles frequently on segment VIII. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.39-0.52 long, cylindrical, slightly tapering, moderately imbricated. Cauda 0.21-0.24 long, elongated and narrowly conical, with 2 pairs of lateral setae evenly distributed. Genital plate with 2 setae anteriorly and 8-11 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens light green. Color of mounted specimens yellowish amber. Tarsi brown.

Morphology. Body length 1.55-2.01. Antennal tubercles very prominent, parallel, scabrous. Setae on head and antennae blunt to pointed, inconspicuous. Antennae longer than body, with 4-19 sensoria in a more or less straight line on segment III. Lengths of antennal segments: III, 0.49-0.65; IV, 0.29-0.50; V, 0.26-0.37; VI, 0.12-0.17 + 0.35-0.71. Head width through eyes 0.45-0.50. Rostrum reaches hind coxae, apical segment 0.094-0.140 long, with 4-6 lateral setae and 0-5, usually 2, surface setae in addition to the usual 3 apical pairs. Second hird tarsal seg-

ment 0.112-0.124 long. Abdominal sclerites and tubercles absent. Segments VII and VIII each with 4 dorsal setae. Cornicles 0.49-0.64 long, cylindrical, slightly tapering, moderately imbricated. Cauda 0.20-0.36 long, elongated and narrowly conical, with 4-6 lateral setae and frequently with 1-2 preapical setae. Setae on anal plate as in alate viviparae. Genital plate with 2 setae anteriorly and 9-13 along posterior edge, rarely with 1 or 2 additional setae in the center of the plate.

MALE. Generally similar to alate viviparous female. Antennal segment III with 56-79 scattered sensoria, IV with 18-27 and V with 11-21 in addition to the primary sensorium. Apical rostral segment 0.099-0.104 long, with 1 pair of lateral setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.148-0.158 long. Cornicles 0.23-0.26 long, cylindrical. Cauda 0.14 long, conical, with 8 setae apically.

OVIPAROUS FEMALE. Essentially the same as the apterous viviparous female. Apical rostral segment 0.099-0.115 long, with 2-3 lateral setae and 0-2 surface setae in addition to the usual 3 apical pairs. Hind tibiae scarcely swollen, with 34-68 pseudosensoria scattered over the middle 2/3 of the segment. Genital plate with 2 setae anteriorly, 20 scattered over the middle of the plate, and 22 along the posterior edge.

Types. In the USNM. Types of rosaefolium Theobald in the British Museum.

Distribution. Worldwide. Eastern U.S.: Widespread.

Collections studied. PENNSYLVANIA: Mount Royal, 29 April, 1953 (J. O. Pepper), strawberry; State College, 5 June 1969 (J. O. Pepper), wild rose. OHIO: Columbus, 29 May 1931 (A. N. Tissot), rose. ILLINOIS: Effingham, 18 June 1929 (Frison and Hottes), rose. MARYLAND: Salisbury, 22 Jan. 1962 (T. Bissell), strawberry. NORTH CAROLINA: Blowing Rock, 8 June 1960 (Smith and Tuatay). FLORIDA: Avon Park, 25 Apr. 1950 (D. E. Wolff), rose; Dunnellon, 30 Apr. 1934 (H. V. Anderson), rose; Gainesville, 25 Aug 1914 (A. C. Mason), rose; 2 Feb. 1923 (A. H. Beyer), rose; 13 Feb. 1923, same data; 2 Nov. 1926 (H. E. Bratley), rose; 21 Nov. 1927 (Bratley and Tissot), rose; 15 Dec. 1927, same data; 14 Mar. 1928 (A. N. Tissot), rose; 15 May 1928 (R. Stanley), Verbena sp.; 15 Feb. 1931 (A. N. Eddins), rose; 26 May 1936 (A. N. Tissot), rose; 3 May 1939, same data; 25 Feb. 1953 (L. C. Kuitert), rose; 6 Apr. 1955, same data; 19 May 1955 (K. Corbett), rose; 6 Dec. 1960 (S. H. Kerr), rose; 31 Jan. 1961 (L. C. Kuitert), rose; Homestead, 26 Feb. 1971 (D. O. Wolfenbarger), rose; Jacksonville, 9 June 1941 (D. F. Barcus), rose; Leesburg, 9 Apr. 1932 (A. N. Tissot), rose; 20 Apr. 1933 (M. D. Leonard), rose; 3 Dec. 1933, same data; Orlando, 23 Feb, 1934, same data; 15 Mar. 1934, same data; Pensacola, 21 Jan. 1934 (P. F. Robertson), rose; St. Augustine, 4 May 1949 (L. L. Masters), rose; Winter Park, 25 Mar. 1963 (R. N. Holman),

rose. MISSOURI: Columbia, 19 May 1905 (Hayhurst), rose. OREGON: Corvallis, 22 Aug. 1954 (C.R.A.), primrose. FSCA, CFS, HBB, JOP.

Biology. This species is essentially autoecious on rose and strawberry. Eggs are laid on both plants and true migration does not occur (Hille Ris Lambers 1949). In tropical and subtropical climates, the species lives parthenogentically throughout the year on both plants, particularly rose. This may also occur in temperate climates on roses grown in greenhouses, but this has not yet been reported.

Distinguishing characteristics. Alate viviparae with sensoria on antennal segments III and IV; apterous viviparae with numerous sensoria the length of segment III. Dorsal sclerotic patch absent. Cornicles cylindrical, without apical reticulations. Cauda elongate, narrowly conical, approximately 1/2 the length of the cornicles.

Figure 13.--Rhodobium porosum (Sanderson). A-D, alate viviparous female: A, head and antennal segments I-III; B, rostrum (2 x scale); C, cornicle; D, cauda; E-G, apterous viviparous female: E, head and antennal segments I-III; F, cornicle; G, cauda; H-I, male: H, head and antennal segments I-V; I, cauda; J-L, oviparous female: J, head and antennal segments I-III; K, hind tibia; L, cornicle.

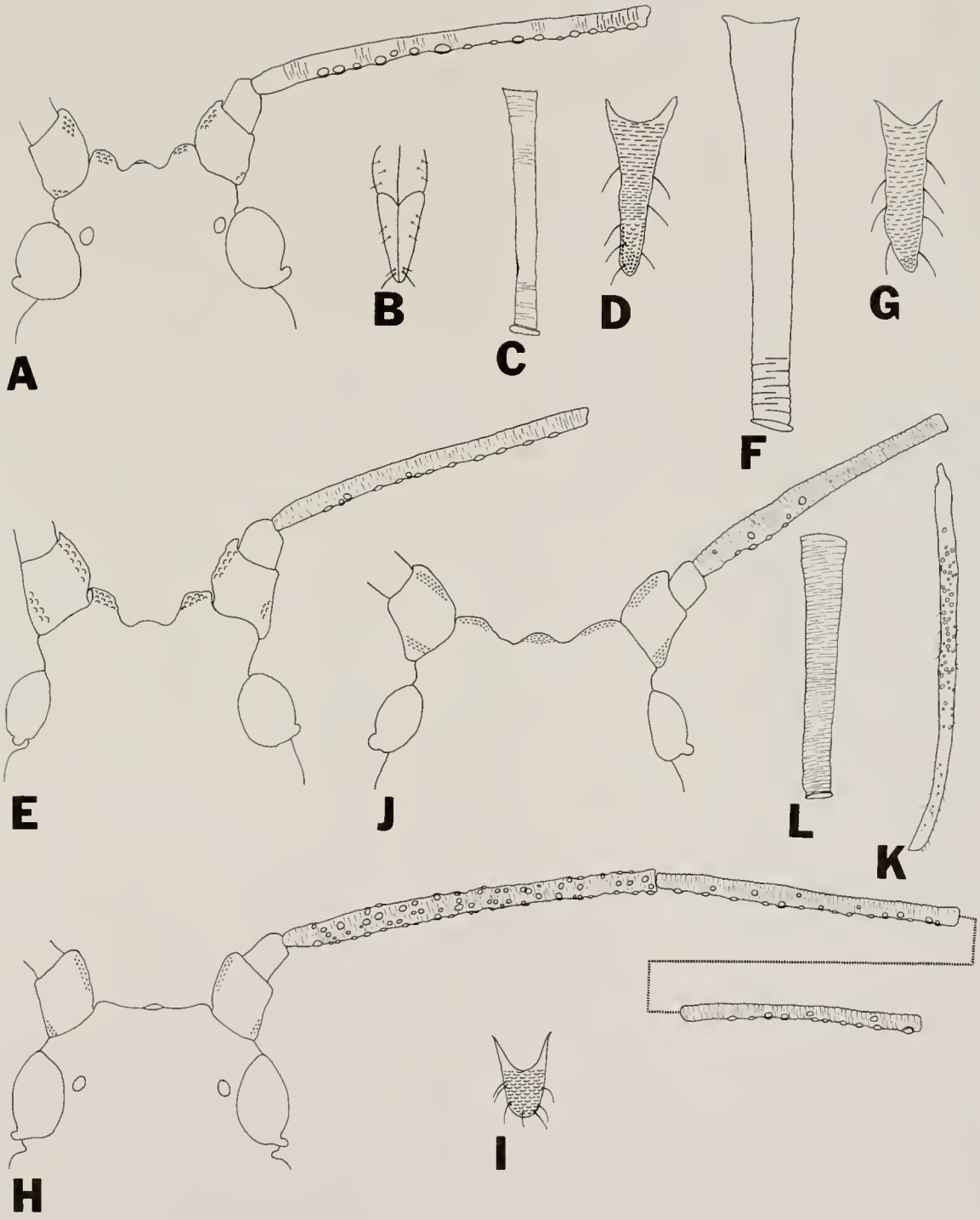

Figure 13

GENUS FIMBRIAPHIS RICHARDS

Fimbriaphis Richards 1959:248.

The genus Fimbriaphis is closely related to Rhodobium Hille Ris Lambers and can be separated from it by the presence of fibrillar margins on the secondary sensoria of alate viviparae, the absence of secondary sensoria on antennal segments IV and V in alate viviparae and the absence of secondary sensoria in apterous viviparae.

Distinguishing Characteristics. Antennal tubercles very prominent, parallel to slightly converging, scabrous; median tubercle prominent. Secondary sensoria, which have fine, cilia-like, marginal fimbriations, restricted to antennal segment III in alate viviparae, absent in apterae. Rostral segment III with at least 3 pairs of lateral setae. Alate viviparae with or without a pigmented sclerotic patch; apterae without. Cornicles cylindrical, straight or curved with flange oblique, imbricated. Cauda elongate, greater than 1/2 of length of the cornicles, narrowly conical, constricted medially.

Type. Fimbriaphis fimbriata Richards.

Distribution. Nearactic.

Key to Eastern U.S. Species of Fimbriaphis

1. Alate viviparae with a pigmented sclerotic patch on the dorsum of the abdomen; second fork of media midway between first fork and margin of wing; terminal filament of apterous viviparae of second and later generations 0.39 mm or longer; on Fragaria and Vaccinium sp. other than V. macrocarpon. . . . . .fimbriata

   Alate viviparae without a pigmented sclerotic patch on the dorsum of the abdomen; second fork of media much closer to margin of wing than to first fork; terminal filament of apterous viviparae less than 0.35 mm; on Vaccinium macrocarpon and Chamaedaphne. . . . . .scammelli

Fimbriaphis fimbriata Richards

Figure 14

Fimbriaphis fimbriata Richards 1959:250.

FUNDATRIX. Coloration. General color of living specimens green. General color of mounted specimens pale yellow. Apex of antennal segment V and segment VI brown. Tarsi brown. Rest of specimen pale yellow.

Morphology. Body length 2.12-2.32. Antennal tubercles very prominent, slightly converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae shorter than body, without secondary sensoria. Lengths of antennal segments: III, 0.35-0.36; IV, 0.22; V, 0.21-0.22; VI, 0.13-0.14 + 0.26. Head width through eyes 0.45-0.50. Rostrum surpasses middle coxae; apical segment 0.108-0.122 long, with 5-6 lateral setae and 2-3 surface setae in addition to the usual 3 apical pairs.

Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.115 long. Abdomen transversely wrinkled, without pigmented areas. Abdominal segments VII and VIII each with 4 dorsal setae; tubercles absent. Cornicles 0.43-0.56 long, cylindrical, slightly curved with flange oblique, imbricated. Cauda 0.32-0.34 long, elongated and conical, not constricted, with 4-6 lateral setae and usually with 1 preapical seta. Anal plate with 12-14 setae evenly distributed. Genital plate with 2 setae anteriorly and 8-13 along posterior edge, rarely with an additional seta in the center of the plate.

ALATE VIVIPAROUS FEMALE: Coloration. General color of living specimens dark green. General color of mounted specimens amber. Basal 1/4 of femur and base of tibia pale to yellowish amber, rest of femur and apex of tibia brownish amber. Tarsus light brown. Lateral abdominal sclerites and dorsal patch brown on a pale background. Cornicles amber basally, yellow apically. Cauda and anal plate yellowish amber. Genital plate brown. Rest of specimen amber.

Morphology. Body length 2.05-2.25. Antennal tubercles moderately prominent, slightly converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae subequal to body length or slightly shorter, with 10-16 sensoria in a single row on segment III. Lengths of antennal segments: III, 0.51-0.63; IV, 0.39-0.45;

V, 0.38-0.41; VI, 0.16-0.18 + 0.52-0.55. Head width through eyes 0.41-0.46. Rostrum does not reach middle coxae; apical segment 0.112-0.119 long, with 5-6 lateral setae and 2-4 surface setae in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3. Second hind tarsal segment 0.112-0.124 long. Wing venation normal; second fork of media midway between first fork and margin of wing. Lateral tubercles on sclerites on abdominal segments II-IV, rarely also on I and on presiphuncular sclerite. Abdominal segments I-IV with an irregularly shaped dorsal patch; segment VII with 2 dorsopleural bars connected to lateral transversely sclerotic areas which are separated from the postsiphuncular sclerite on VI. Abdominal segments VII and VIII each with 4 dorsal setae; segment VIII usually with 1 or 2 tubercles between the 2 middorsal setae which are only slightly larger than the seta base; sometimes dorsal tubercles are also present on segment VII. Cornicles 0.40-0.50 long, cylindrical, straight, imbricated. Cauda 0.28-0.32 long, more than 1/2 the length of the cornicles, elongate and narrowly conical, constricted medially, with 2 pairs of lateral setae and 1-2 preapical ones. Anal plate with 12-18 setae evenly distributed. Genital plate with 2 setae anteriorly and 9-11 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Essentially the same as the fundatrix except the antennae are subequal to the body length. Lengths of antennal segments: III, 0.53-0.60;

IV, 0.35-0.37; V, 0.33-0.35; VI, 0.12-0.15 0.39-0.45.

Sexual forms are unknown.

Types. Holotype and paratypes in the Canadian National Collection.

Distribution. Nearactic. Eastern U.S.: New Jersey.

Collections studied. NEW JERSEY: Hammonton, 26 May 1966 (P. E. Marucci), blueberry. WASHINGTON: Bellingham, 27 Apr. 1960 (Eide), strawberry. BRITISH COLUMBIA: Terrace, 19 July 1960 (W. R. Richards), Rosa sp. USNM.

Biology. The biology of this aphid has not been studied, but in view of the apparent biology of Fimbriaphis scammelli, it seems that fimbriata occurs on Fragaria and Vaccinium myrsinites Lam. year-round without host alternation, and Richards' collection from Rosa sp., a single alate viviparous female, is a drift.

Distinguishing characteristics. Secondary sensoria of alate viviparae with ciliated margins. Alate viviparous female with a dorsal sclerotic patch.

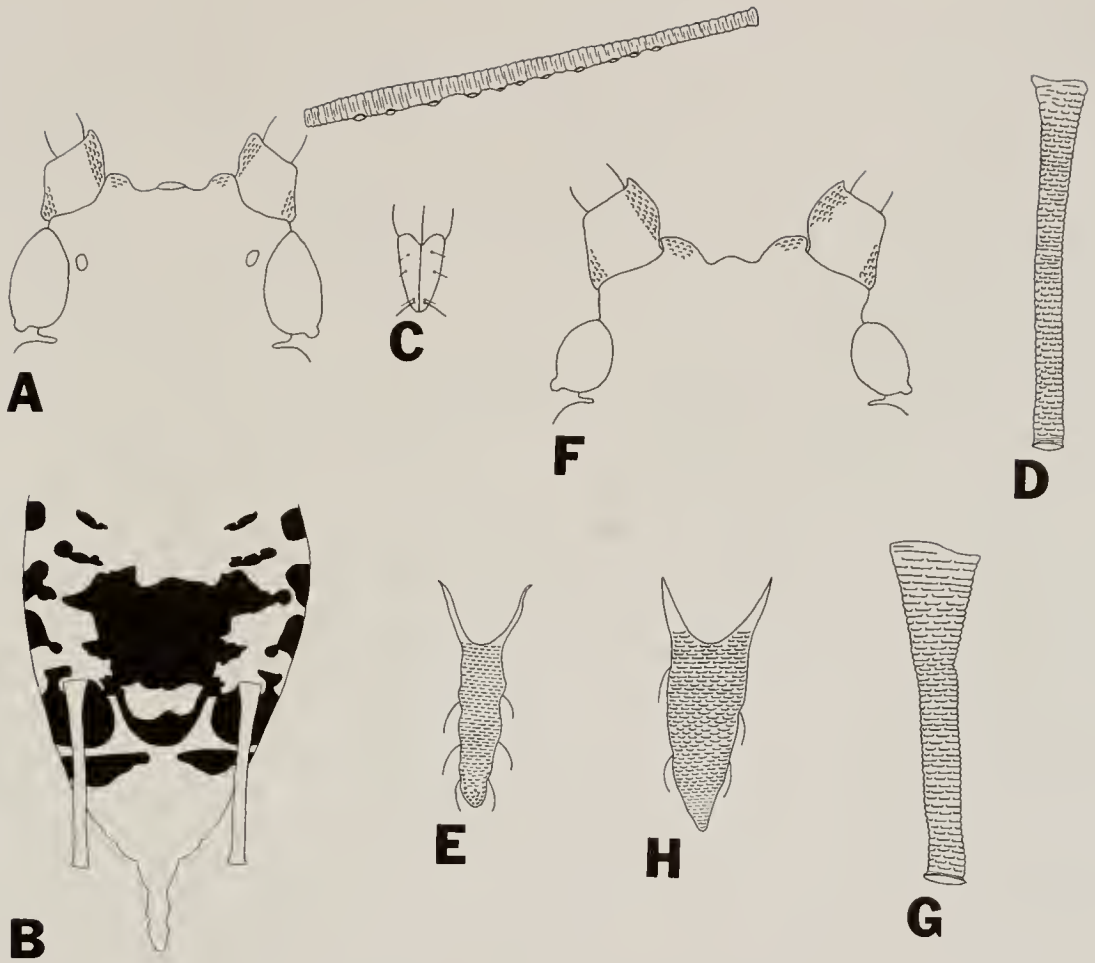

Figure 14.--Fimbriaphis fimbriata Richards. A-E, alate viviparous female: A, head and antennal segments I-III; B, sclerotic pattern on abdomen (1/2 scale); C, rostrum; D, cornicle; E, cauda; F-H, apterous viviparous female: F, head; G, cornicle; H, cauda.

Fimbriaphis scammelli (Mason)

Figure 15

Myzus scammelli Mason 1940:18.
Fimbriaphis scammelli (Mason). Richards 1959:249.

ALATE VIVIPAROUS FEMALE. Coloration. General color of living specimens green. General color of mounted specimen amber. Basal 1/5 of femur and base of tibia pale yellow; apex of femur and of tibia and tarsus brownish amber. Lateral sclerites brown, rest of abdomen pale. Cornicles amber basally, pale apically. Cauda and anal and genital plates yellow to yellowish amber. Rest of specimen amber.

Morphology. (Morpholectotype) Body length 1.67. Antennal tubercles moderately prominent, parallel to slightly converging, scabrous. Setae on head and antennae pointed, inconspicuous. Antennae subequal to body length, with 8-11 sensoria in a single row on segment III. Lengths of antennal segments: III, 0.45; IV, 0.31; V, 0.28; VI, 0.13 + 0.32. Head width through eyes 0.39. Rostrum does not reach middle coxae; apical segment 0.097 long, with 2 pairs of lateral setae and an additional surface seta in addition to the usual 3 apical pairs. Setal formula of first tarsal segments 3:3:3.

Second hind tarsal segment 0.101 long. Wing venation normal; second fork of media much closer to margin of wing than to first fork. Lateral abdominal tubercle on segment IV on 1 side only. Abdominal segments VII and VIII each with 4 dorsal setae; dorsal tubercles absent. Cornicles 0.36 long, cylindrical, straight, imbricated. Cauda 0.20 long, more than 1/2 the length of the cornicles, elongated and narrowly conical, constricted medially, with 5 lateral setae and 2 preapical setae. Anal plate with 14 setae evenly distributed. Genital plate with 2 setae anteriorly and 9 along posterior edge.

APTEROUS VIVIPAROUS FEMALE. Coloration. General color of living specimens light green. Mounted specimen wholly light yellowish amber.

Morphology. Body length 1.40-1.75. Antennal tubercles very prominent, slightly converging, scabrous. Setae on head antennae pointed, inconspicuous. Antennae shorter than body, without secondary sensoria. Lengths of antennal segments: III, 0.25-0.34; IV, 0.15-0.20; V, 0.18-0.21; VI, 0.11-0.13 + 0.23-0.34. Head width through eyes 0.35-0.41. Rostrum surpasses middle coxae; apical segment 0.090-0.112 long, with 2-5 lateral setae and 0-3 surface setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.099-0.101 long. Abdomen transversely wrinkled, without pigmented areas. Abdominal segments VII and VIII each with 4 dorsal setae; tubercles absent. Cornicles 0.31-0.40 long, cylindrical, straight to curved with flange oblique, imbricated. Cauda 0.19-0.24 long, elongated and narrowly conical, constricted

medially, with 4-6 lateral setae and 0-2 preapical setae. Anal plate with 10-16 setae evenly distributed. Genital plate with 2 setae anteriorly and 9-10 along posterior edge.

MALE. Coloration. Similar to alate viviparous female. Abdomen with brown transverse bars dorsally on a pale background.

Morphology. Body length 1.45-1.50. Antennae slightly longer than body, with 28-40 scattered sensoria on segment III, 12-18 in an irregular row on segment IV, and 9-13 in a straight line on segment V in addition to the primary sensorium. Lengths of antennal segments: III, 0.46-0.49; IV, 0.25-0.34; V, 0.29-0.31; VI, 0.14-0.16+ 0.29-0.43. Head width through eyes 0.35-0.42. Apical rostral segment 0.076-0.086 long, with 2-3 lateral setae and 0-3 surface setae in addition to the usual 3 apical pairs. Second hind tarsal segment 0.092-0.097 long. Abdominal tubercles absent. Abdominal segments III and IV each with a distinct pleural spot on each side; segment VII with a transverse bar loosely connected to the post-siphuncular sclerite. Cornicles 0.25-0.32 long. Cauda 0.11-0.12 long, acutely conical without constriction, with 5-6 terminal setae. Other features similar to alate viviparous female.

OVIPAROUS FEMALE. Essentially the same as apterous viviparous female. Hind tibia swollen, with 66-94 pseudosensoria scattered over middle 3/4 of segment. Genital

plate with 2 setae anteriorly, 10-13 in 3 irregular rows across the middle of the plate, and 12-20 in 2-3 irregular rows across the posterior edge.

Types. In the U.S. National Museum I found 2 of Mason's original cotype slides and 5 cotype slides which had been remounted by R.N.B. Prior in 1967. I remounted the original slides and designated the following types:

Lectotype (USNM No. 52854): apterous viviparous female, Whitesbog, N.J., summer 1914 (H.B. Scammell), on cranberry, in the U.S. National Museum. Morpholectotype: alate viviparous female, same data as lectotype. Morpholectope: oviparous female, Pemberton, N.J., 12 Nov. 1919 (H.B. Scammell), on cranberry. Allolectotype: male, same data as oviparous morpholectotype. Paralectotypes: 1 oviparous female and 1 male, same data as oviparous morpholectotype; 6 apterous viviparous females, Whitesbog, N.J., 2 and 3 June 1916 (H.B. Scammell), on cranberry, in the U.S. National Museum.

Distribution. Nearactic. Eastern U.S.: New Jersey, Pennsylvania.

Collections studied. In addition to the types given above, MASSACHUSETTS: South Hanson, 18 Oct.-2 Nov. 1939 (H.J. Franklin), cranberry. NEW JERSEY: Pemberton, 12 Nov. 1914 (H.B. Scammell), cranberry; 28 Oct. 1 16 (H. B. Scammell), cranberry. PENNSYLVANIA: State College, 16 July 1961 (J. O. Pepper), sweeping Chama ne calyculata (L.) Moench. USNM, FSCA, JOP.

Biology. The biology of this species has not been adequately studied, but collection records indicate that it lives year-round on cranberry (or Chamaedaphne) without host alternation. Chamaedaphne is in the Ericaceae, which is closely related to the Vacciniaceae, and therefore I believe represents another primary host rather than an alternate host.

Distinguishing characteristics. Secondary sensoria of alate viviparae with ciliated margins. Alate viviparous female without a dorsal sclerotic patch.

Figure 15.--Fimbriaphis scammelli (Mason). A-D, alate viviparous female: A, head and antennal segments I-III; B, rostrum; C, cornicle; D, cauda; E-G, apterous viviparous female: E, head; F, cornicle; G, cauda; H-K, male: H, head and antennal segments I-V; I, sclerotic pattern on abdomen (1/2 scale); J, cornicle; K, cauda; L-O, oviparous female: L, head; M, hind tibia; N, cornicle; O, cauda.

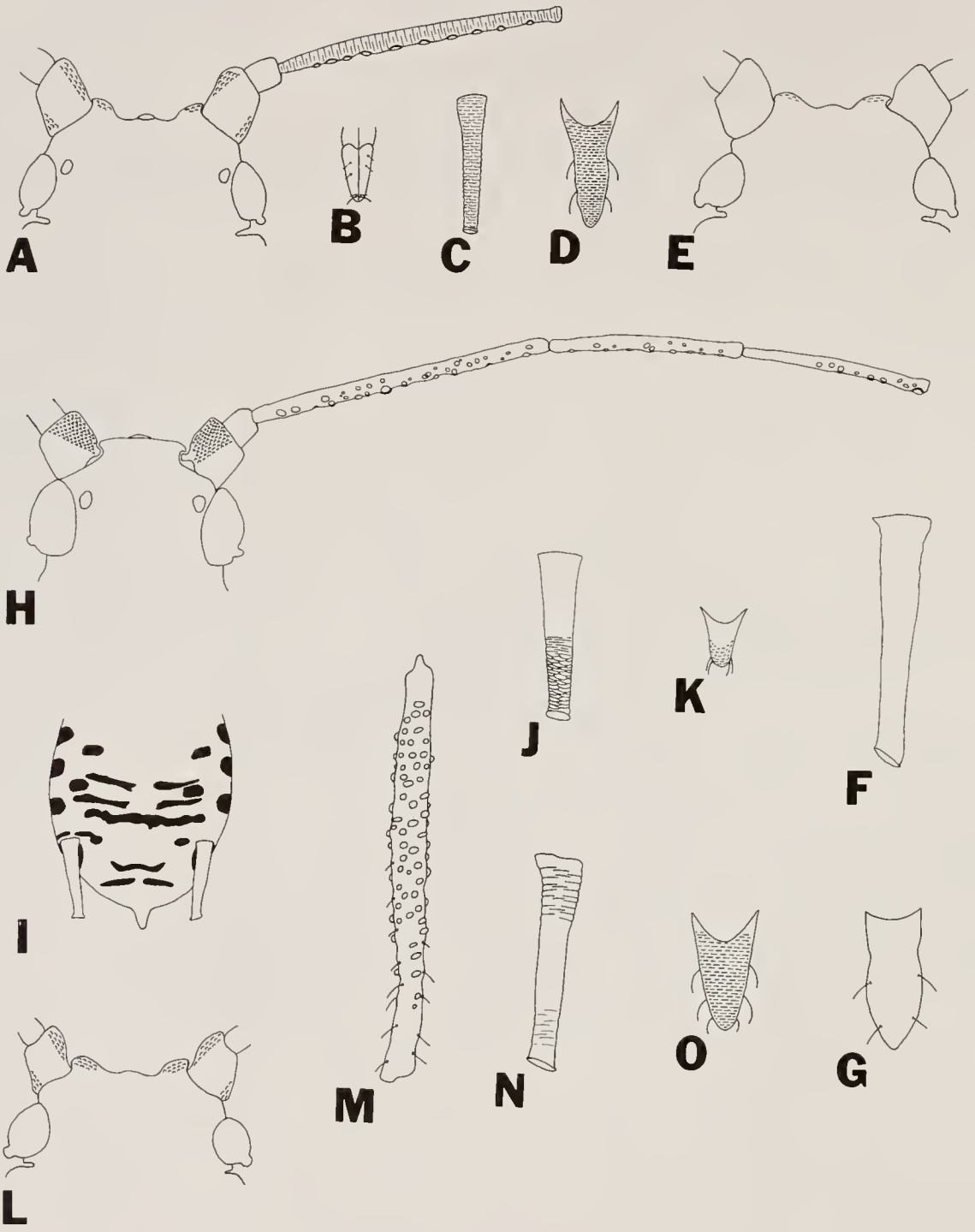

Figure 15

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BIOGRAPHICAL SKETCH

Richard Joseph Nielsson was born on March 31, 1943, in Amarillo, Texas, to Francis Thomas Nielsson and Mildred (Sweet) Nielsson. He attended grammar school at St. Joseph School, Sheffield, Alabama, and Holy Trinity School, Norfolk, Virginia. He graduated from Notre Dame High School for Boys, Niles, Illinois, in June, 1960, and entered the University of Chicago, Chicago, Illinois, in September of that year. After one year, he transferred to Auburn University, Auburn, Alabama, where he received a Bachelor of Science in Zoology in December, 1964.

In January of 1965 Nielsson entered the graduate school of Auburn University to begin work toward the Master of Science in Zoology. In September, 1965, he switched to Entomology, and received the Master of Science in Entomology in December, 1966. He was employed by the Department of Zoology-Entomology, Auburn University, as a student teaching assistant from September, 1963, to December, 1964, and as a graduate teaching and research assistant from January to December, 1966.

In December, 1966, Nielsson moved to Gainesville, Florida, where he worked as a Laboratory Technician II for Dr. Robert E. Waites until September, 1967, when he started to study for the Doctor of Philosophy Degree on a full-time basis. He has been employed as a graduate research assistant

by the Department of Entomology and Nematology, University of Florida, since September, 1967.

Richard Joseph Nielsson was married June 5, 1965, to Catherine Elizabeth Burgess, daughter of Otis Clay Burgess and Mignon (Brunson) Burgess of Auburn, Alabama. They have two children, Susan Elizabeth, born March 28, 1966, and Aric Thomas, born August 2, 1969.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Dale H. Habeck, Chairman
Associate Professor of Entomology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for thedegree of Doctor of Philosophy.

A. N. Tissot
Professor Emeritus of Entomology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Dana G. Griffin, III
Assistant Professor of Botany

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Harvey L. Cromroy
Associate Professor of Entomology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Thomas J. Walker
Professor of Entomology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

F. W. Zettler
Assistant Professor of Plant Pathology

This dissertation was submitted to the Dean of the College of Agriculture and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

June, 1971

Dean, College of Agriculture

Dean, Graduate School

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